Chapter 4
Transition to Industrial Forestry in Finland

4.1 De Facto Transition 1900–1960

4.1.1 Introduction

The aim of this section is to review the timeline of de facto *transition to sustainable industrial forestry in Finland during 1900–1960 with particular reference to the indicators of sustained yield forestry and to the ratio between industrial and non-industrial use of timber.*

Sustained yield forestry has been observed traditionally in different countries by applying several alternative indicators (Judeich 1869; Saari 1937, 1949; Lihtonen 1959; Kuusela and Nyyssönen 1962; Linnamies 1970; Clawson and Sedjo 1984; Johann 1984; Schuler 1984; Parry et al. 1983; Adamowicz 2003).

In Finland, one formal committee (Komitén… 1874) and another informal committee (Kommittén… 1916) each made sustainability assessments by comparing the timber increment with the timber drain. In both cases non-sustainable use of forests was indicated at the national level, which was not true in light of later evidence.

Valid and reliable statistics on the state and changes in forest resources was a remote dream until the 1920s in Finland and remains as such in most tropical countries.

Comparison of the stem volume increment and timber drain (or cut) has been commonly used in order to assess sustainable forestry. It is valid, however, only for a normal forest with equal age, site, and tree species classes (Box 2.2) or in situations not too far from such ideal circumstances.

The stem volume increment in an old growth forest could be close to zero. Even in large old-growth forests no logging would be allowed in order to practice sustainable forestry, if this indicator would be followed. If young forests would be prevailing, the sustainable cut should be remarkably lower than the estimated stem volume increment.

M. Palo and E. Lehto, *Private or Socialistic Forestry?: Forest Transition in Finland vs. Deforestation in the Tropics*, World Forests 10,
DOI 10.1007/978-90-481-3896-8_4,

We previously made a pilot study (Palo 2006) on de facto and *de jure* transition from preindustrial forestry to industrial forestry in Finland. In this book we have advanced both the theory and the empiricism from the 2006 study.

4.1.2 Observing De Facto Forest Transition

A cutting budget method could take into account the present structure and quality of the growing stock in comparison with the budget and the timber drain (Lihtonen 1943; Kuusela and Nyyssönen 1962). It has been most widely applied in Finland since the 1960s. Financial criteria have also been developed since the early innovations by the German forester Martin Faustmann (1849) (Box 4.1).

Box 4.1 Indicators of Sustained Yield Forestry

Women fear the end of this world – men the end of forests.

This is a common proverb in Finland. Through centuries this fear has largely guided forestry laws and other forest politics and policies in Finland. Due to non-geometric forms of trees and their random distribution in huge land areas as well as the highly dynamic growth processes of different tree species on varying sites and atmospheres it has been difficult to plan national forest inventories in order to produce valid and reliable data on forest resources.

We described the model of the Normal Forest earlier (Box 2.2). If the different age classes are close to the model of the Normal Forest, timber sustainability can be reasonably indicated with the ratio of timber increment/timber drain. Gyldén (1853) used this indicator and later on it was applied in various occasions (e.g., Kommittén… 1916).

In those days, when the structure of Finland's forests was far away from the Normal Forest this comparison yielded biased outcomes. It underestimated sustained cutting possibilities due to excess quantities of old growth timbers with low growth potential but large volumes of growing stock.

If increment exceeds drain, the growing stock is increasing. In the opposite case, the growing stock is decreasing. However, this comparison is not indicating sustainable cutting possibilities ("allowable cut"). They can be larger than increment in the case of excess old growth and smaller than increment in the opposite case. Saari (1937, 1953) clarified the concept in Finland and, e.g., Parry et al. (1983) in the United States.

Finland was the first country in the world to complete the first systematic sampling-based national forest inventory and to publish its results (Ilvessalo 1924; Box 4.13). Only then were valid and reliable estimates of stem volume increment produced. The field works of the inventory were implemented in

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Box 4.1 (continued)

1921–1924. A specific method was developed for computing the potential sampling error for the applied systematic sampling. Most likely this was done prior with the same innovation of the general sampling theory in statistics.

It was the first major effort by the newly established Finnish Forest Research Institute. Funding of the inventory was facilitated by A.K. Cajander's first government. He was then Director of the Forest Service and still also maintained his previous chair of Professorship in Silviculture at the University of Helsinki. A Committee for Taxation made a proposal for funding this inventory for the government (Helander 1949).

However, it was soon realized that the data on growing stock and increment alone could not help to decide the sustainability of timber harvesting. Reliable data on timber drain was also needed. In 1927, the Forest Research Institute received a budget for a national timber drain survey on objective sampling basis.

The funding was allocated by Väinö Tanner's Social Democratic government with Mauno Pekkala as a Minister of Agriculture. Pekkala was a forester and a civil servant of the Forest Service. Professor Eino Saari (1934) directed this comprehensive survey and published the findings.

Then it was possible to make the elementary indicator of sustainability: the comparison of timber increment with timber drain. The increment was as an annual average 3 million m^3 higher than the drain in 1925–1932. Accordingly, the growing stock was most likely not declining. The difference was within the margin of potential sampling error. Therefore, no reliable evidence was found that the growing stock had been increasing (Saari 1934).

The national forest inventory and the national timber drain survey were repeated at the end of the 1930s and in the 1950s. Afterwards both have become continuous activities carried out by the Forest Research Institute. Methods have been improved along with the arrival of aerial photos and satellite images as well as innovations in the sampling theories.

Along with the decline of the consumption of fuelwood and timber by households since the 1950s, the survey of timber drain has become simpler and less costly. The drain estimates are based on estimates of wood consumption with estimates of the natural drain due to wild fires, decay, and other damages.

Saari (1937) pointed out sustainable cut as the most relevant indicator of sustainable yield of timber. He noted that one problem in computing this indicator is that it will remain to some extent subjective. His view was that the only way to achieve larger volumes of growing stock was to decrease drain lower than increment. Later in the 1960s the idea of increasing increment by intensification of forest management won ground.

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Box 4.1 (continued)

Lihtonen (1943) was pioneering methodologically in this issue with empirical computations in his PhD dissertation. Ilvessalo computed with Lihtonen's method two successive estimates for national sustainable cut during the 1950s. Computation periods were extended 10–20 years into the future. The computations were made for the Committee of Industrialization, where the leading idea first time in Finland was economic growth. The nucleus of this growth was the expansion of forest industries during the 1950s and beyond. By 1955 it appeared that under sustainable forestry restriction no more investments in capacity expansion were feasible (Kuusela 1999).

The capacity of forest industries expanded, however, faster than expected. The Forestry Planning Committee invited a team of four forest scientists to recompute the potential sustainable cut computations. Rotation long-time horizons were applied along with prospects of decline in fuelwood consumption and roundwood exports as well as expansion in industrial uses of processing residues and imports of roundwood. An even age class distribution within assumed rotations was one primary aim with target growing stocks. A forest management intensification program was a novelty to increase the sustainable cut, which was nearly 5 million m^3 higher than the second plan by Ilvessalo (Kuusela 1999).

In the 1960s the greatest period of national planning of sustainable cut with alternative forest management intensifications followed (Heikinheimo and Palo 1972).

Here we use the change in the volume of growing stock of timber from a decreasing phase into a balance or an increasing phase as an indicator of transition from a non-sustainable era to sustained yield forestry, which was regarded in Sect. 2.1 as the major objective for industrial forestry. As another indicator for industrial forestry we use the date when the industrial utilization will exceed the non-industrial utilization of roundwood.

De jure sustainability and de facto sustainability are identified with the model of Fig. 4.1. When a new law is launched, it is by no means guaranteed that its enforcement will also become effective. First of all, the rationale of the law has to be formulated according to commonly accepted concepts of justice and equality.

Second, the enforcement organization has to be competent, motivated, and reasonably free from corruption. The existence of a reference group to give an example of law-based behavior is also beneficial. Some external groups may successfully lobby for or against the law even during its enforcement.

De facto *sustained yield forestry* was observed as a transition from declining growing stock to increasing growing stock of trees during 1900–1910 (Fig. 4.2). The data are based on scientifically designed and implemented national forest inventories by the Forest Research Institute since 1921 (Ilvessalo 1924).

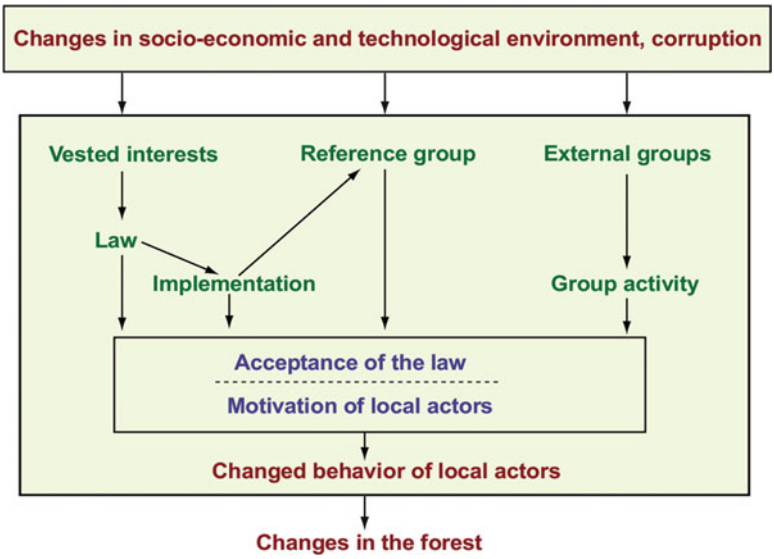

Fig. 4.1 A model of transition from a *de jure* to de facto situation under a new law (Modified from Stjernqvist 1973)

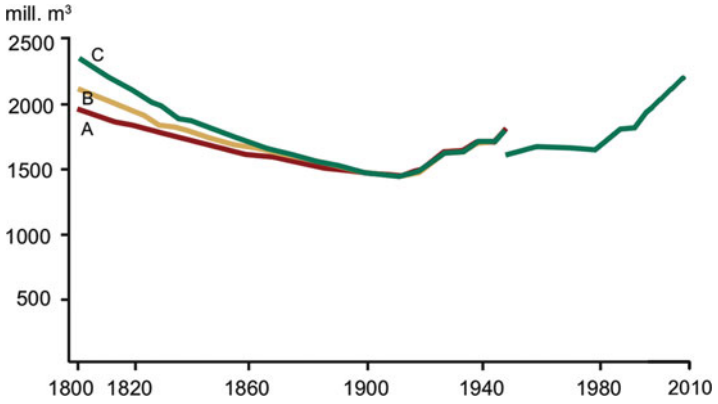

Fig. 4.2 Growing stock of timber in 1800–2008 in Finland with three scenarios for 1800 due to increasing unreliability of the data (Myllyntaus et al. 1998; Ylitalo 2010). The solid line is broken by 1945 due to 12% reduction of forest area after the war against the Soviet Union

The prior estimates have been derived from the 1921 estimate by deducting the annual increment and increasing the annual drain estimate. The last reliable estimate for 2004–2008 was 2,200 million m^3 (Ylitalo 2010).

Thus, today the growing stock is at the level of the medium scenario in 1800. The further we depart backwards to 1800, the more unreliable the data become. Therefore, three scenarios were constructed for the data for 1800–1923. Another time series (Fig. 4.3) indicates that the increment has been predominantly higher than the drain

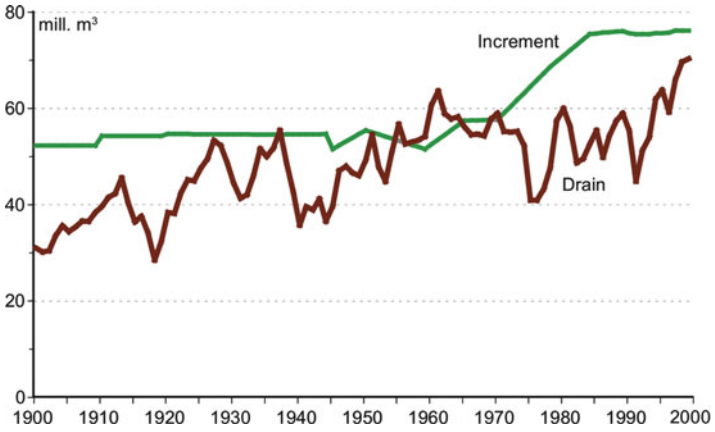

Fig. 4.3 Stem volume increment and timber drain in Finland, 1900–2000 (Data: Sevola 1999)

of the growing stock of trees since 1900. Figures 4.2 and 4.3 mutually complement and support each other.

This finding of the de facto sustained yield forestry starting point of Figs. 4.2 and 4.3 was unexpected, because it precedes *de jure* sustained yield forestry in private forests in 1917. The timing of 1900–1910 is even more surprising, because the maturation of the real effects of a new law is a time-consuming process. Also a comprehensive enforcement of the Private Forestry Law did not start before the 1930s due to the restricted staff in the enforcement of the 1917 Act.

4.1.3 Increase of Growing Stock in the State Forests

The State Forest Service with 40% of total forests had a half a century to operate toward sustained yield forestry, but that time was primarily used for closing the access of local people to these forests (Ruuttula-Vasari 2004). Learning how to make timber sales profitable had been another major activity. It was not until the late 1920s that proper silviculture and until 1930s that large-scale drainage of peatlands were mobilized (Leikola 2006).

However, some positive impacts towards sustainability were created by the new state Forest Service. In 1861 it was assessed by visual survey that the state forests had some 8.8 million sawlog-sized trees and about 5 million trees suitable for railway sleepers. The minimum dimensions were for sawlog trees as 10 in. diameter at the height of 18–24 ft and for sleepers 9 in. diameter.

The next assessment in 1883–1902 found 36 million sawlog trees (20 ft/10 in.) and 43 million sleeper trees (20 ft/8–9 in.). The assessment was carried through partly by measuring individual trees, and partly by applying systematic sampling

(line survey). In a third assessment in 1905–1915 an estimate of 77 million sawlog trees and 110 million trees of sleeper-size was made (Helander 1949).

Ernst Nylander was responsible for the last assessment. The methods of the three assessments were not exactly the same. Also, some inaccuracies in observations are possible but the increasing trend is reasonably clear and it can be concluded that the amount of large dimension trees increased remarkably during the previous half a century. Most likely the establishment of the state Forest Service was the primary cause of this increase in the growing stock by excluding the local people from exploiting the state forests.

4.1.4 Role of Market Institutions

We may credit primarily the market institutions for this early breakthrough of de facto sustained yield forestry. Naturally, there had existed interplay between policies and markets, but finally the structural changes, such as ending shifting cultivation (Box 3.4), tar distillation and wooden shipbuilding, have been decisive in this unexpected finding.

The scale of forest fires started to decrease along with the decrease of shifting cultivation and tar distillation. Increasing stumpage prices and forestry incomes also played their positive roles. The effective enforcement of the Great Land Reform was, of course, a necessary precondition for the viable markets and increasing of real stumpage prices.

The depression of exports during the World War I also contributed to this increase of the growing stock (Figs. 4.2 and 4.3). A similar depression and an increase in the growing stock were also visible during World War II. These phenomena are also market-based, when exports are decreased by the wars.

The long trend of a decrease of wood consumption by households produced a similar effect. Farmers, peasants, tenants, and other households used wood not only for heating and construction but also for seasoning of grains, for fences, furniture, barrels, and for a number of other daily items. This use of wood was estimated as 18 million m^3 in 1850 (Soininen 1974), and as 13.5 million m^3 in 1913 (Kunnas 1973).

4.1.5 Natural Versus Artificial Regeneration

The Forest Act of 1917 and the Private Forest Law of 1928 favored natural regeneration as the first alternative to be considered in regeneration. The texts of the laws were interpreted in such a flexible way that the foresters could interpret the opposite in the later post-1950 enforcement of the 1928 Law. Direct sowing and planting as a method of regeneration in clear-felled sites remained at a small scale during 1929–1949, but reached 30,000 ha in 1950. The area was doubled during the 1950s (Holopainen 1968).

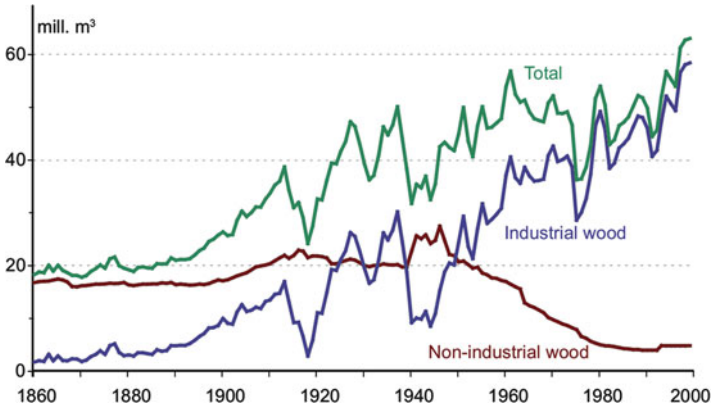

Fig. 4.4 Utilization of domestic roundwood in Finland, 1860–2000 (Data: Sevola 1999)

The establishment of the Forest Tree Breeding Foundation in 1947 was a forerunner of the later expansion of sowing and planting of trees. Two years later the Central Forestry Association Tapio organized a Silvicultural Campaign (Metsämarssi) in order to promote sowing and planting of trees, tending of juvenile stands, and thinnings. Juho Kusti Paasikivi, the President of the Republic, attended personally the opening ceremonies of the campaign. A total of nearly a half a million citizens (10% of the total population) participated in these manual silvicultural works during the campaign.

Clear-fellings expanded along with the mechanization of logging toward the end of the 1950s. This practice required artificial regeneration – direct sowing and planting. It was also believed that sowing and planting would produce more wood with lower risks during the rotations than natural regeneration. About 10,000 ha were artificially regenerated by 1955. A dramatic increase to 107,000 ha took place over the next 15 years. Prescribed burning with direct sowing had been widely practiced in the 1950s but afterwards primarily planting (Leikola 2006).

4.1.6 Industrial Use Exceeds Non-industrial Wood Consumption

The total utilization of domestic roundwood in Finland rose from 26 to 54 million m³ in 1900–1960 (Fig. 4.4). This total is composed of different uses, such as domestic industrial use, domestic non-industrial use (primarily fuel, and also some timber for construction, fencing, poles, pilings, etc.), and exports. *Domestic industrial use surpassed the non-industrial use in 1925–1950.*

Therefore, we have terminated the transition to industrial forestry in the 1950s. Non-industrial use grew larger than industrial use only during the exceptional times of the Great Depression of the early 1930s and during the World War II and immediately afterwards. The period 1925–1950 coincides well with the high share of 70–90% of forest products in all the commodity exports during those years (Fig. 4.5).

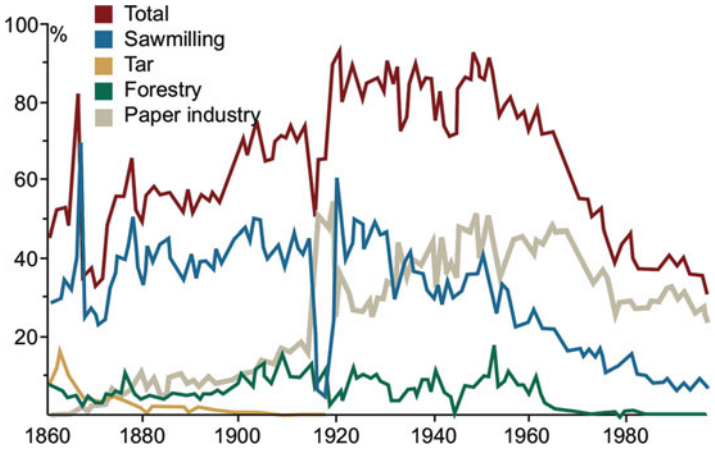

Fig. 4.5 Exports of forest products as shares of the total value of commodity exports in Finland, 1860–1996 (Seppälä et al. 1980; Statistics Finland 1983–97)

4.1.7 Conclusion

We may conclude that Finland transited from preindustrial to industrial forestry during the first half of the twentieth century based on de facto sustained yield forestry and finally on the excess of the industrial use of timber in comparison with the non-industrial use.

Next, we shall turn to the issue of which factors have supported the transition from preindustrial to sustainable industrial forestry. It will be evident that this transition was not the result of any single factor but a combination of multiple factors, as assumed in our theoretical frame (Chap. 2).

In fact, the model of Fig. 2.4 has guided our search for the underlying causal factors of the transition of the Finnish forestry from the preindustrial to the industrial forestry. We shall apply the same model for studying the underlying causes of deforestation in the tropics in Chap. 5.

4.2 Ecological Conditions

4.2.1 Introduction

The purpose of this section is, on the bases of ecological economics (Sect. 2.3) and the model of Fig. 2.4, to review the ecological conditions that may have supported the transition to sustainable industrial forestry in Finland with some reference to tropical ecological conditions.

Finland is located between Sweden and Russia and between the 60th and 70th latitudes (Map 1.1). This location is such a northern one that only Iceland, as a

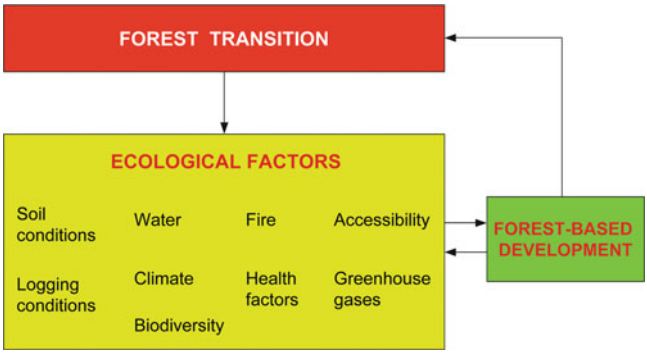

Fig. 4.6 Ecological factors in the interaction with forest transition via forest-based development

whole country, is comparable worldwide in this respect. For example, in the western neighboring country Sweden most of the population lives south from Finland.

In those peripheral latitudes there existed traditionally few options for raising welfare: the Icelanders have been fishing and processing fish and the Finns have been growing trees and processing timber. In those simple means of production and with strong comparative advantages in their foreign trade, the two nations have created some of the highest standards of living among all the nations.

Due to the warm Gulf Stream in the Atlantic Ocean along the Norwegian coast, not only Norway but also Sweden and Finland enjoy much milder climate in comparison with the same latitudes in Siberia, Alaska, and the northern territories of Canada.

There exist a number of ecological factors with interactions with various forest-based development activities and via this linkage to forest transition (Fig. 4.6).

4.2.2 Location and Watercourses

The two sea bays provided good sites for harbors and access to the Baltic Sea and to the international oceans (Map 1.1). Finland has also enjoyed the proximity to Russia and especially to St. Petersburg, which played an important role in providing markets for pulp and paper among other goods, especially during 1860–1917. Neither was Finland too far away from the most rapidly industrializing countries of western Europe and from their expanding demands for forest products during their industrialization phases.

Finland has nearly 200,000 lakes and hundreds of rivers, creeks, and long shorelines of the Gulf of Finland and Bothnia (Pohjanlahti), which facilitated long-distance transportation of timber by floating with minimal investments to improve the infrastructure.

Water power was also readily available in Finland along the rapids of the numerous rivers, where all the water-powered sawmills as well as pulp and paper mills were

established. Also fresh water availability for the pulping and papermaking processes was easy to organize. Log floating used the various watercourses. It was essential for floating that in the Finnish weather conditions winters had a lot of snow, which melted during spring and created flooding. This made numerous tiny creeks available for floating (Box 4.2 and 4.3).

Box 4.2 Traditional Floating of Timber (Helander 1949; Pakkanen 2006)

Finland is a land of forests, creeks, rivers, lakes, and seas. Watercourses played in a number of ways a decisive role in the traditional forest-based development. First of all, running water gave power to the sawmills from the sixteenth to the early twentieth century. Second, water was needed for steam generation at the steam engine-powered sawmills starting in 1857.

Water was also powering mechanical pulp and paper mills since the 1860s. Water-powered sawmills and pulp and paper mills were located by rapids inland, while steam-powered sawmills were located mostly at river estuaries. Many harbors facilitated an easy access for exports. In all locations one common aspect was that floating and rafting of timber were the primary ways of haulage of timber those days.

Norway has pioneered large-scale timber floating in Scandinavia since the late Middle Ages, when foreign demand appeared for her timber. Some floating skills arrived to Finland via Sweden but also via Russia. Floating in Finland has been practiced for longest time in Pohjanmaa (Ostrobothnia). Tar barrels were transported in boats along rivers and boards and planks of sawnwood were floated loose or in rafts as early as the middle of seventeenth century. For a long time log floating was done on a mini-scale due to small sawnwood production and easy accessibility of timber even by horse.

Jakob Stenius Jr. was a vicar of Pielisjärvi parish in eastern Finland in 1769–1809. He got a nickname "Rapids Jakob" due to his secular activities in promoting the clearance of rapids for lowering the level of water in lakes, for floating of timber and construction of water-powered mills. The Finnish Economic Society (Finska Hushållningssällskapet 1819) in its review of forestry to the Senate proposed clearance of rapids for gaining higher value for forests among other measures.

Böcker (1829/1929) identified the construction of floating routes as one measure to increase the value of forests. Gyldén (1853) described a number of methods for renovating floating routes. The Forest Service initiated improvements in the floating routes of three National Forests already in the 1860s. Also the Board of Roads and Watercourses (Tie- ja vesirakennushallitus) implemented at the same time similar works in one more National Forest. However, only minor improvement works were carried out before the twentieth century (Laitakari 1960).

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Box 4.2 (continued)

After the expansion of sawmills powered by steam since the 1860s the scale of floating started to expand. First, each company floated its own logs separately but after many conflicts appeared among the floaters a law to regulate this activity was enacted in 1873. Open access to practice floating and rafting of timber under this law in any watercourse was given to anybody.

The 1902 Water Law anticipated that the state or some of the floaters or their joint associations would take care of clearing and rehabilitating the watercourses. Floating could be ordered as a cooperative activity run by an association established by the floaters. In 1926 the total length of floating courses was estimated as 47,000 km. About one quarter of this length was under cooperative floating. There were 26 floating associations.

In 1984 the floating of loose logs was stopped on the River Iijoki and the logs were hauled by trucks to the mills. On the River Kemijoki, the longest river in Finland (550 km), floating was stopped in 1991. The termination of timber floating was not only an economic loss but also a great cultural shock for the local people (Snellman 1996). Timber floating has played multiple cultural roles in Finland (Sect. 4.6). Even the Finnish Parliament Building has been decorated by Pekka Halonen's 1925 painting of "Timber Floaters" and the Bank of Finland has a glass painting by Juho Rissanen from 1933. Both paintings have prominent interior locations.

In order to facilitate profitable floating and rafting both relevant institutions and technology had to be created. A fishing act had been enacted as early as in 1766. It ordered that the arteries of waterways had to remain open. A specific act for timber floating was enacted in 1873. Its enforcement could take place in each waterway only after specific local inspections had been implemented.

Thus the River Kymijoki received its regulations only in 1880 and the River Kemijoki not before 1921. The act facilitated floating of logs belonging to different owners at the same time under a common leadership. One requirement was that in general the logs had to be debarked, with some exceptions.

The 1902 Water Law defined the rights and duties of the floaters, fishermen, water traffic operators, and land owners on the shores of the watercourses. The previous debarking requirement was maintained. The floaters had the right to walk along the shores of the watercourse. They had to pay compensations to the fishermen and other losers due to the various harmful activities of floating. This law was reformed in 1962. A novelty in this law was the harmonization of floating interests with the interests of hydropower generation.

The total length of the floating routes was estimated as 50,000 km at the top of floating activities in the 1940s. Many technological improvements were implemented along the floating routes in order to support free running of the logs and to prevent congestions of logs and, in this way, to lower the floating costs.

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Box 4.2 (continued)

Clearing the rapids of big stones and rocks was started around the end of the nineteenth century and the activity culminated in the interwar period of the twentieth century. The worst rapids and power plants had to be passed by constructing bypasses, which were wooden v-shaped constructions. Dams and many other types of permanent or temporary aids also had to be created.

The lakes and seas were crossed by gathering logs into cribs surrounded by booms and then towed or warped across the lake. Earlier, horses on pontoons were used in warping but later on steam boats, and finally diesel boats for towing. Single logs were later bound with steel wires into bounds. Presently the bounds are joined together into a raft of 1,200 bounds, which is about 20,000 m^3 or 400 truckloads.

Under favorable weather such a raft can be towed 270 km in about a week. Today floating rafts are undertaken only in Lake Saimaa and along the seacoasts. Recently, the amounts of timber rafting have been 10–20% of the level from two decades ago. Today some wood is also hauled on water by vessels.

Box 4.3 Matti Palo's Own Experience in Timber Floating Along the River Iijoki 1959–1960

Floating of timber was practiced in the past in Finland in different ways in creeks, main rivers, lakes, and seas depending on the circumstances. I had personal experience in the spring of 1959 of creek floating along Mertajoki, a creek of the River Iijoki, just north of Oulu. Floating in the creeks should be done during the flooding after snow has melted. We were three forestry students, Tero Ollila, Kusti Seppälä and I, working with nine local timber jacks. The team had made a contract of piecework including carrying pulpwood to the creek and floating them about 10 km to the main river.

We had first to pull manually down to the creek 10,000 m^3 of pulpwood of a length of 2 m. We were a little late in the middle of May from the top of flooding and the distance of the piles and the waterfront was becoming longer by the day. Therefore, we worked 15 h a day and slept rather short nights at a camp within 3 km walking distance. This manual labor was the hardest I have ever done in my career. There was a lady chef at the camp to provide us food. All 12 of us slept in the same room in beds organized in two stories.

After all pulpwood was in the water we stepped into boats and started driving pulpwood down the creek. We were three students in the same boat – two of

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Box 4.3 (continued)

Photo 4.1 Traditional labor-intensive floating of timber along a creek (Photo: Sakari Pälsi 1923)

us rowing and one sitting at the bow piloting us beyond the stones and other obstacles. Each of us had a 3-m-long pole with an iron hook at one end. This pole was used to pull logs from the shore or push them if they were stopped by stones (Photo 4.1). We passed several rapids. At one moment our boat hit a stone and one of us slipped into the water. We managed to pull him back to the boat by his backpack.

Finally, the log driving was done but some work was still ahead for us three. The boss or our team said that we students had worked so hard, like the locals, that we would receive our full pay. Originally we were promised only 75% of the regular pay.

However, we had to bring the boat upstream next to the camp. This appeared a most difficult activity due to the strong current, which impeded our rowing. The local people had mastered pushing the boat upstream by wooden bars but we did not master the technique. Luckily, it started to snow and we could pull the boat along the shores, but it was also an extremely heavy undertaking.

In May 1960 we experienced floating in the main river Iijoki (Photo 4.2 introduces a main river similar to Iijoki River). The main river was equipped with various aids to support fluid floating. Wooden constructions were created in the rapids to guide the logs along the middle of the river. The river is 370 km long, one of the longest rivers in Finland. A large amount of timber was floated there. At the estuary of the river was a system for identifying the different owners of the logs. Each company had marked its logs with its own hallmark.

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Box 4.3 (continued)

Photo 4.2 Traditional floating of timber in a main river with a slow current. Lumberjacks have time to play cards on the *right* and have coffee served by local women on the *left*. The main floating tools, a hook and a pole, in the *front* (Photo: Hildur Larsson, according to our assumption from the 1920s)

After identification of the logs there was a machine in order to bind the loose pulpwood into rafts. Then these rafts were tugged to pulp mills and sawmills in Oulu and Kemi along the Gulf of Bothnia (Pohjanlahti). An alternative was that the logs had been loaded nearby into ships for exports.

In order to feed suitable amounts of logs to these downstream systems there was a major instrument about 5 km upstream to regulate the flow of logs. It was a memorable occasion to establish this system across the 300 m wide river. We were 80 workers sitting in 20 boats, each boat linked together as a long chain. Two workers were rowing at the same bench.

This convoy of boats pulled a huge wooden construction across the river. The construction was made by binding 4–6 heavy logs together and linking these bounds one after another as a chain of 300 m. By rowing we had to pull the upper end of this log chain on the other side of the river, where it was immediately bound firmly on the shore.

We had to row strongly because there was some current in the river pulling our construction downstream. If we had not rowed strongly enough, the whole undertaking would have had to be repeated after complicated preparations.

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Box 4.3 (continued)

We followed the loud commands from the foreman and made the target by the first attempt. It may have already been done once a year over the last 100 years of the floating history in this river.

I am rather confident that after our floating experience along a creek in May 1959 the pulling of logs to water was mechanized without any delay. Soon afterwards the whole system of creek floating was replaced by truck haulage. The floating of loose logs along the main River Iijoki continued until 1984 but I am also confident that our experience in the 20-boat convoy in May 1960 was perhaps the last effort before mechanization. So today I feel happy that I had a chance for these historical experiences.

4.2.3 Soils and Climate

The northern location has, however, provided relatively poor climatic and soil conditions for agriculture. This has decreased the opportunity costs of sustainable forestry. Agriculture has been favored more than forestry by formal institutions, which, on the other hand, has artificially increased the opportunity costs of sustainable forestry. Finland became nearly totally covered by natural forests after the Glacial Age. Poor sites of peatlands and fell tops, along with some bare rocks and beaches, remained without forest cover.

The climate in Finland has also favored forestry in the way that cold winters with frozen soils and snow have facilitated timber extraction traditionally by horses (Photo 4.3) to the watercourses. In tropical climates the productivity of traditional log extraction has been lower (Photo 4.4).

The forest soils and climate have been resistant towards erosion after large-scale shifting cultivation (Map 3.1) and clear-felling. Also some other ecological factors have been favorable for transition into sustainable forestry in Finland.

Soil productivity with management impacts for tree growth has been second highest after Sweden in comparison with the other countries in the boreal zone (Kuusela 1990). The current annual tree stem increment of the growing stock is today 4.2 m³/ha as a national average (Ylitalo 2010). Temperature is the minimum growth factor in tree growing in Finland. Finland is 1,100 km long from the south to the north, which allows a high variety in climate conditions and increment.

One third of the soils in Finland have been peatlands or bogs. The large scale of peatlands has been typical to Finland's ecology and geography. Until today one third of them have been drained for improving tree growth, one third for agricultural purposes, and one third have been legally protected for nature conservation. A minor share has been under production of peat for energy and humus.

Photo 4.3 Winter, with snow and ice, supported traditional log extraction in Finland (Photo: Finnish Forest Research Institute)

Photo 4.4 Log extraction by a water buffalo in the Philippines (cf. the load with Photo 4.3) (Photo: Martti Saarilahti)

4.2.4 Forest Ecosystems

Forest ecosystems in natural conditions tend to survive in a dynamic equilibrium. Natural or human-made disturbances may change the process. Fire and storm are examples of natural disturbances, which may create openings in the forest. Selective logging, clear-felling, or clearing forest for shifting cultivation or farming provide examples of human disturbances. If the disturbance is occasional, the forest ecosystems have the property of resilience trying to return to the original state. This may take a long time due to the different phases of successions or may never be reached (e.g., Perry 1994).

Finland is covered mostly by boreal forests. Under these conditions natural regeneration after a disturbance nearly always is successful – sometimes sooner, sometimes later (Photos 3.2 and 3.3). It is considered one of the greatest ecological benefits for Finnish forestry. It played a key role also after shifting cultivation was terminated around 1900. The open sites were easily regenerated.

The two coniferous endogenous tree species of highest commercial value are pine (*Pinus sylvestris*) and spruce (*Picea abies*). Also non-coniferous birches (*Betula pendula* and *B. pubescens*) and aspen (*Populus tremula*) have had some commercial value. Finland houses naturally only a total of 22 endogenous tree species. The scarcity of tree species has been an ecological advantage for forestry.

The most valuable tree species in Finland grow still naturally in various sites. In fact the share of natural regeneration was 74% of all seedling and young thinning stands by 1980. Earlier this share was higher, but it declined to 56% by 2005 (Peltola 2008). The era of national forestry programs since the 1960s aimed largely toward artificial regeneration – direct sowing or planting. Also the other formal institutions have favored artificial regeneration (Kalela 1961).

4.2.5 Contrasting Tropical Conditions

If the tropical rainforests remain without human disturbances, they are also inclined to develop in a dynamic equilibrium. After a disturbance has taken place a succession toward its original state will be generated. Old secondary tropical rain forest can be quite diverse, if there are long enough time intervals between disturbances and regeneration.

The scale of open site, the elevation, erosion sensitivity, and population pressure after a disturbance are decisive in the success of regeneration and the kind of succession. The risk for sicknesses, such as malaria for people and tsetse fly for horses and cattle, deteriorate the health of loggers and has partly prevented log extraction by animals (Kamarck 1976).

Tropical heavy rainfalls have stronger physical impact on soils than is the case in the boreal zone in Finland. Tropical soils are also more erosion sensitive. Therefore, large open spaces are always more difficult to regenerate. The scale of open site

decides also the composition of a succession depending on the varying mechanisms of seed disposals.

Presently, tropical natural forests support more forest people than temperate and boreal forests. This is leading at a low level of human development mostly to a continuous pressure for forest degeneration and deforestation. Tropical rainforests may be composed of thousands of different tree species, which complicates their management and utilization (e.g., Goldsmith 1998).

Forest plantations in the tropics provide, however, more profitable investment opportunities than in Finland (Sect. 5.3).

4.2.6 Conclusion

Easy natural regeneration conditions in Finland promoted rapid reforestation of degenerated and cleared forests, which again increased the growing stock of trees. Practically no erosion followed logging. It is evident from this review that the ecological conditions have favored Finland in the transition to sustained yield forestry. This looks especially likely in comparison with the ecological conditions in the tropics.

Until 1960 forestry was supported by the low capacity utilization of men and horses in agriculture during the wintertime, which again was ecologically most fitting for logging. Cold winters favored extraction by horses with sledges and numerous watercourses supported floating of timber during spring and summer. A few commercially important tree species favored silviculture, logging, and processing of timber.

4.3 Informal Institutions

4.3.1 Introduction

The aim of this section is to review the informal institutions of knowledge, market, and community in support of the transition of Finland to sustained yield forestry and industrial forestry in 1900–1960.

We follow here North's (2005) division of informal and formal institutions and their enforcement as key factors of forestry transition under economic, social, and political change. Formal institutions of the next section cover property and other state institutions as official rules for organizations and individuals.

Informal institutions are here comprised of knowledge, market, and community institutions. However, cultures, religions, beliefs, and traditions also belong to informal institutions (Fig. 2.2).

Markets do not operate efficiently when guided only by informal institutions. Various formal judicial institutions must precede informal market institutions.

The situation of "law and order" is a fundamental requirement for the viability of the markets. Open access to forests has to be closed by establishing clear and strong property institutions with an effective enforcement.

4.3.2 Knowledge Institutions

Until the beginning of the twentieth century timber sales had been done by concessions or stumpage sales. In both cases the firms did the logging. Hannikainen, the new Director-General of the Forest Service, started experimenting with logging by the Forest Service itself in order to improve the profitability of timber sales and to increase revenues to the state. Hannikainen had a scholarly background. He had alone published a forestry journal for several years. He had also published a textbook on forest policy.

Hannikainen was also elected as the first chairman of the new Society of Forest Science in 1909. The Society was aimed to support young scientists and to publish research reports. Hannikainen organized salaried vacancies at the Forest Service for seven foresters to prepare their PhD theses in the early 1910s. The Acta Forestalia Fennica-series for publishing scientific papers was initiated in 1913.

A new interest on forestry issues among the scholars of different non-forestry disciplines at the University of Helsinki appeared in the early twentieth century. For example, Väinö Voionmaa studied the role of shifting cultivation and economic geography, and Heikki Renvall analyzed the exports of forest products and supported with a specific study the forest ownership by industry corporations (Raumolin 1990).

J.T. Hanho studied the development of the sawmilling industry. Just about all of the scholars emphasized the importance of forestry in the national economy. The threat of expansion of deforestation and forest degradation continued because no reliable knowledge existed until the 1920s about the sustainability of forestry under continuous expansion of forest industries (Raumolin 1990).

A general compulsory primary education and the first few high schools were started in the latter half of the nineteenth century. Forestry ranger schools were established: one in 1875 and four more in 1905. The University had been established in Finland already in 1640. In 1908 forester education was moved from the College of Evo to the Imperial Alexander University in Helsinki (presently University of Helsinki), where the education in agriculture had been transferred some years earlier (Halonen 2008).

This transformation was important to strengthen the scientific basis of the curriculum. Postgraduate education was also created by this institutional change. Accordingly, in 1908–1944 about 30 PhD degrees were passed in forestry (Halonen 2008).

At the State Forest Service and at the University in Helsinki and partly elsewhere some forest research was already carried out in the early twentieth century, but the main occasion in this front was the establishment of the Forest Research Institute in Helsinki (Metsäntutkimuslaitos Metla in Finnish) in 1917. Metla was created via an act of the Senate (Michelsen 1995).

Many talented scientists became the first professors and researchers at Metla. Soon an increasing number of research reports, articles, publications, and also popular books and newsletters were launched. Jointly the reforms of the university education and Metla produced the know-how and information bases for sustained yield forestry (Figs. 4.2–4.4).

Professor Yrjö Ilvessalo led three first national forest inventories until the 1950s. Finland was the first country in the world in 1924 to publish results from such an inventory (Ilvessalo 1924). Finland was, along with Norway and Sweden, pioneering in the whole world on the methodology of systematic sampling of field plots for national assessment of forest resources.

The inventory results were complemented with the findings of the national wood utilization survey (Saari 1934). The two periodically repeated research activities finally solved the centuries-old statistical dilemma of how to assess the sustainability of forest resources in the country (Box 4.1).

Finland's forests were found in the 1920s larger by volume and increment than the various committees and most people had previously believed. But the capacity of the forest industries was expanding, while the exports and the household consumption of roundwood also remained at high levels. Therefore, the follow-up of changes in forest resources was indispensable for forest-based development.

Logging and transportation methods and technologies had remained the same for about a century until the 1940s. An ample supply of labor with low wage levels did not provide motivation for innovations. A private body Work Efficiency Association (Työtehoseura ry) established in 1942 a department for developing productivity in logging in farm forests. The Federation of Finnish Woodworking Industries also established a logging research and development unit (Metsäteho) in 1945.

Metsäteho's aim was first to study work efficiency in industrial logging (Photo 4.6) and to discover objective criteria for tariffs for manual piece work in logging. Gradually mechanization studies were initiated, especially during the 1950s. Power saws, farm tractors, and trucks appeared in logging, extraction, and transportation, indicating a revolution of mechanization to arrive more intensively later. In fact, the labor input in forestry was at its peak in the early 1950s (Fig. 4.7).

The paradigm of sustained yield forestry became later on more sophisticated in Finland. In 1948 a group of six leading silviculturists defined a system of thinning from below as the only acceptable method of forest management (Appelroth et al. 1948; Leikola 2006).

This paradigm (Box 4.4) was adopted by the Private Forestry Boards. This kind of thinning became an informal institution in order to escape from the prevailing "creaming" practices of the best trees, which were believed to degrade forests. An orthodox phase or normal science of sustained yield forestry had arrived in Finland in the 1950s in Thomas Kuhn's (1962) terminology (Box 2.1).

Among the various political ideologies after liberalism (Box 3.13) *socialism* was important in 1917–1918 but also played its role later in protecting the social conditions of the loggers (e.g., Tanner Government reforms above). A *neo-classical economics regime* with practically no government economic planning played its role during the interwar period 1920–1939. However, some new laws to regulate forestry were launched (Fig. 4.8).

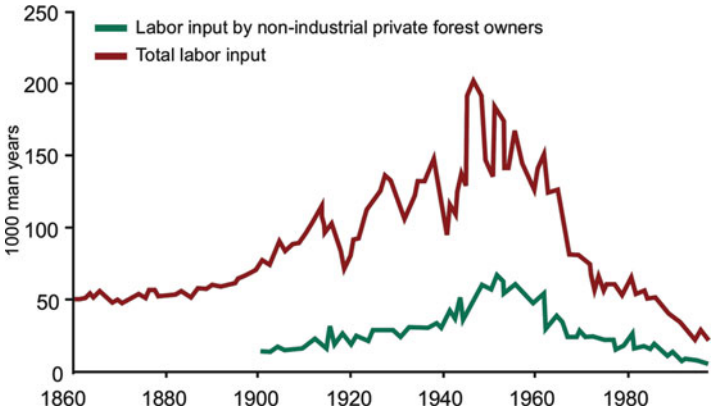

Fig. 4.7 Labor input in Finnish forestry, 1860–1997 (Elovirta 1988)

Box 4.4 The Paradigm of Stand-Wise Natural Regeneration of Forests in 1948

Declaration (*summarized*)
The past two national forest inventories indicate poor silvicultural conditions in the Finnish forests. The situation has appeared as a consequence of the prevailing selection cutting method: creaming of the best timbers. Based on research findings and on long-range experiences we wish to declare the following.

1. The application of uneven-aged (selection) method lacks preconditions in Finland. The sites are not fertile enough, the climate is not favorable, and our tree species are not adequately shadow tolerant, tough and resilient in order that the selection method would lead even in satisfactory outcomes. Furthermore, logging would become more costly with damages to the remaining trees and thus the net income would become lower in the selection method with comparison to the even-age stand method.
2. When the selection method proper is unsuitable to Finland, it is clear that creaming the best trees without any silvicultural considerations (and other practices similar to it) is out of question. That would soon lead to degraded and unproductive forests. Therefore, it is up to every forester and forest ranger to understand the risks linked with this practice for the future forests of Finland and to ban using them.
3. Replication of point 2 in other words.
4. and 5. The traditional selection method should be replaced by silvicultural natural regeneration methods, which fit better to the Finnish conditions and produce even-age structure in stands. A shelter tree method is aimed for spruce (*Picea abies*) stands. Here seedlings are created under protective

(continued)

Box 4.4 (continued)

mature trees, which are tended by cutting smaller trees until the regrowth has cleared its way through primary problems.

A seed tree method is aimed for pine (*Pinus sylvestris*) and for birch (*Betula pendula*, *B. pubescens*). Here seed trees have been beforehand identified and managed for this mission. The seed trees are also of high standard by quality. The site has also been prepared to favor the germination of the seeds.

6. Research findings and partial long-term experiences from Finland have proved that these management and regeneration methods prevent tree species of wandering to wrong sites and the genetic degeneration. These methods also speed up the development of the stands, they maximize the quality and yield of the stands, and in this way long, unproductive regeneration times can be avoided, which all increase the financial returns.
7. This transition supports, accordingly, both timber sellers and buyers. Therefore, all foresters and forest rangers should strive towards application of these new methods.

In Helsinki, 13 November 1948

Eric Appelroth	Olli Heikinheimo	Erkki K. Kalela
Erkki Laitakari	Jarl Lindfors	Risto Sarvas

My review
This declaration provides a case of an effective informal institution. It was written by six leading forest scientists and foresters and published as an article in the leading Finnish forestry journal "Metsätaloudellinen Aikakauslehti." No official administrative bodies were involved in this declaration. Still it was adopted as primary guidelines in the official forestry extension and law enforcement work.

The *Keynesian economics regime* started to have its impact in the 1950s in increased government planning, which matched well with the increasing impacts of Social Democratic influences in all of Scandinavia and in Holland. The Keynesian regime to mobilize state interventions by expanding demand in order to increase employment and economic growth appeared clearly in Finland in the 1950s.

A trade union (Suomen Metsänhoitajaliitto) was established for foresters in 1928 (Makkonen 1977). Its mission was to support the employment and salaries of foresters and to promote some forest policy issues. The Union of Foresters organized a consultative seminar and excursion in Rovaniemi in 1951 with the title "The Opportunities of Lapland's Forests."

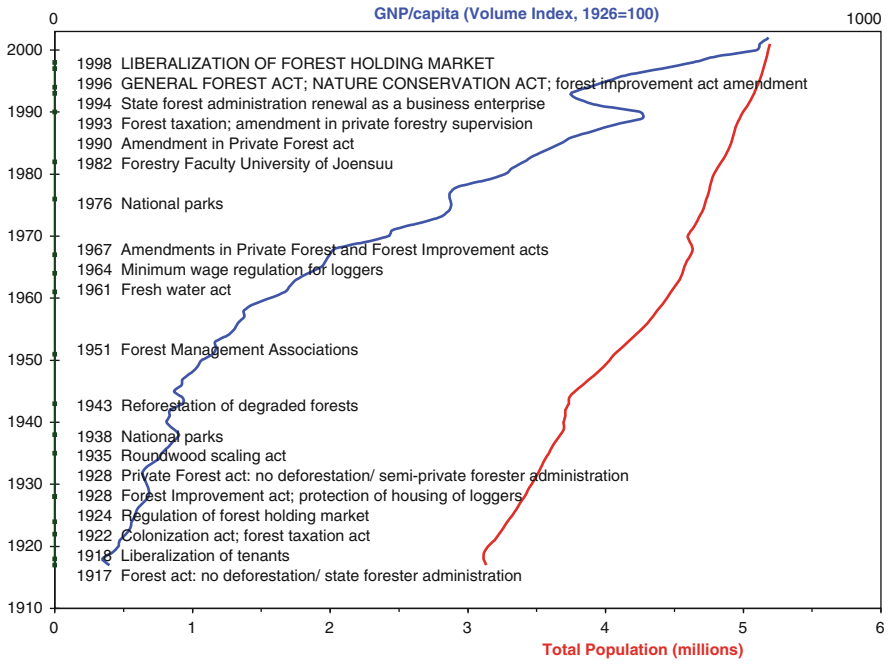

Fig. 4.8 Evolution of forestry legislation in independent Finland with population and income per capita, 1917–2000

Minister Urho Kekkonen participated, along with the most prominent foresters and forest scientists. The lectures on expanded logging by clear-felling and silviculture of these most northern old growth forests in Finland motivated not only lively discussion but also future action by the Forest Service (Kauhanen 1955). New industrial investments by the state also appeared in northern Finland, e.g., a pulp mill in Kemijärvi.

Prime Minister Dr. Urho Kekkonen, President of Finland in 1956–1981, designed and published a program for development of northern Finland with support of government investments in hydropower, mining, and forest industries (Kekkonen 1952). The program had strong influence. By and large it also became enforced with large government investments.

Pioneering individuals have played key roles in diffusing knowledge in support of community institutions. This knowledge has partly been reviewed from abroad but also partly from domestic sources. The period 1900–1960 under our analysis here was a time of consolidating the paradigm of sustained yield forestry and also of rapidly increasing demand for industrial roundwood. It was also a period of rapidly expanding forestry education and research and development. Therefore, knowledge institutions played key roles.

4.3.3 No Corruption in Finland

Transparency International assessed Corruption Perceptions Index from 1995 to 2010 (Transparency International 2010). Finland has been ranked as the least corrupted country for 6 years, and in 5 years as the second least corrupted, as well as five times in the ranks of 4–6 in the world. We may interpret that this situation reflects to a great extent also previous history, because corruption is strongly correlated with time.

Our historians have not identified any past era where corruption would have been widespread in Finland. Even forestry history prior to 1917, when the state owned nearly half of all the forests, cannot illustrate corruption in any wider scale. Only a few cases of individual corrupt forest guards have been reported. The corruption situation today is worse in the tropical countries, Russia, and in the previous socialistic countries than in the industrialized countries (Box 4.5).

Box 4.5 Why Practically No Corruption in Finland?

In 1809 Finland was occupied by Russia in a war against Sweden. Alexander I, the emperor of Russia, gave Finland home rule under the previous Swedish legislation. Finland had to create a corps of civil servants for her own use. The Finnish Senate immediately invited two additional professors of law from Sweden to the University of Turku (established 1640).

Cicero was an ancient Roman scholar. His work "De offices" laid a foundation for studying political science and moral philosophy in Turku according to the models from Germany and Sweden. A foundation for teaching was to convince the students of law that a public office was a duty and its attainment and implementation a moral challenge. Teaching for law students was organized not only by professors of law but also by a professor in practical philosophy. Already by 1812–1813 these studies were so popular that 80–100 students attended the lectures.

In 1817 the Senate ordered a *privilegium exclusivum* for public offices. It was simultaneously ordered that nobody was allowed to be nominated to public offices without university examination. Four kinds of law degrees were created for public offices: a degree of law, a degree of administration, a degree for the imperial Finland's office in St. Petersburg, and a minor degree in cameral affairs. Teaching of moral philosophy and social ethics was a prevailing principle in educating future civil servants and clergymen at the university (Hallberg and Pietarinen 2009).

This kind of education must have created a solid ethical foundation for the Finnish civil servants against corruption. Although forester education was run in a Forestry College outside the university during 1862–1867 and 1874–1907, the same principles must have penetrated there also.

(continued)

Box 4.5 (continued)

Corruption can be regarded as an informal institution undermining both enforcement of the formal institutions and the efficiency of the market institutions (Klitgaard 1987; Bromley 1991). Low-level corruption in Finland supported stopping deforestation around 1900 and the transition to sustained yield forestry later on. Finland has never experienced a military coups or dictatorships, which often create favorable grounds for corruption.

All five Scandinavian countries have been found as a cluster at the least corrupted end of the Corruption Perceptions Index (Transparency International 2010). This helps in identifying factors that may have contributed to this end. Family farmer forest ownership has traditionally prevailed in Scandinavia. The five countries share advanced democracies, not only today but over the last century and a half. A strong tradition has survived in supporting freedom for NGOs and the media.

The prosecutors and courts have been independent and have shared strong democratic cultures. The civil servants have had a culture honoring legal procedures. The Scandinavian peoples have also shared the same religion – a Lutheran protestant one. It has always stressed honesty and fair play towards fellow citizens.

4.3.4 General Market Institutions

Shifting cultivation was terminated during the first decades of the twentieth century – perhaps the latest of European countries. Numerous state laws, acts, decrees, and orders had been launched over three centuries in order to control shifting cultivation (Map 3.1) but with ineffective enforcement.

This time the termination came finally as a market-driven process, although the Great Land Reform and the establishment of the State Forest Service also played key roles. Korhonen (2003) reported that shifting cultivation was decreased also due to decreasing soil productivity, when towards the end of the nineteenth century excess exploitation of the fitting sites took place.

Construction of wooden ships and distillation of tar and their exports started to decline rapidly after a couple of technological innovations. Iron replaced wood, steam engines replaced sails, and tar from coal replaced to a great degree tar from wood during the latter half of the nineteenth century. For centuries the governments had tried unsuccessfully to control tar distillation by various laws, but this termination was also finally a market-driven process.

The linkages of forestry with forest industries and agriculture have been decisive for the future of forestry. Colonization of forests and clearing of forests for farming have been the oldest land use trend from the time immemorial until 1960. The seasonally rotating use of the manpower and horsepower between

farming and logging has been applied for centuries in support of the profitability of both parties until 1960.

The 109 years of the Finnish political autonomy is the longest time of continuous peace in the history of Finland so far. It is called an era of *Pax Russica*. Income taxes and other taxes were relatively low, but some duties were collected from the exports until 1861. Land tax and import duties were the main sources of revenue for the state. The period was favorable for mobilizing new investments and entrepreneurship. Especially so, after steam power was allowed in sawmilling in 1858 and after 1861, when sawmilling was freed from the restrictions of log quotas.

Roundwood markets were the primary arenas of market institutions in Finnish forestry, with sellers and buyers of timber as the main players. Foreign markets also played a role, with exporters and importers as key players. Banks and insurance companies provided additional financial market arenas. Labor markets established the other arenas with employers and employees as the main players. The players in all the markets have been supported by their associations in creating informal institutions and in lobbying formal institutions.

4.3.5 Coops as Market Players

The Pellervo Society was established in 1899 to promote the cooperative movement. The Diet passed a law on the cooperative business in 1901. In the decade to come, hundreds of cooperatives were established. The informal institution to guide the cooperative movement originated from the first cooperative in 1844 in Rochdale, England (Huumo 2006).

In the early 1900s it was realized that a central body for the numerous cooperatives was needed. Accordingly, SOK was established in 1904 with a mission for extension, financing, and wholesale business for the local cooperatives. Cultural activities were also promoted along with extension. The left-wing cooperatives established their own central body OTK in 1916.

Early twentieth century cooperatives were also established in banking and insurance. Soon the coops became countervailing powers to private business by increasing competition on prices, quality, and deliveries. A membership in a cooperative shop brought some monetary returns as a share of the personal purchases but also trained the people for democracy with options to become candidates to the boards and for voting these candidates.

SOK and local coops also established various kinds of industrial processing. Dairy plants were established in every municipality and they were predominantly coops. They survived rather well, whereas cooperative sawmills were failures due to strong volatility of the business cycles of sawnwood. Finally, farmer forest owners took a different course in their joint business.

A forestry cooperative Metsäliitto was established first as a joint stock company in 1934, and after its bankruptcy in 1947 as a cooperative. Its mission was to raise timber prices by exporting roundwood and by establishing its own wood processing mills.

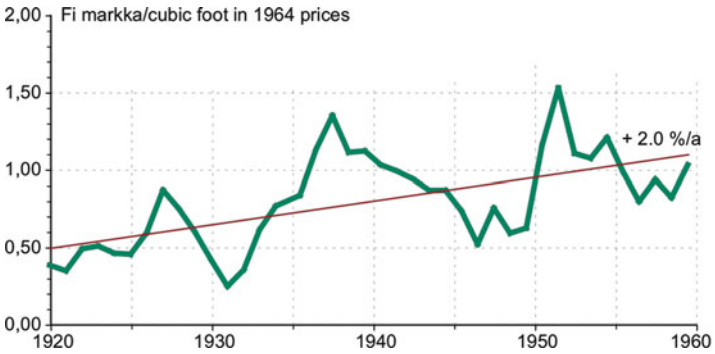

Fig. 4.9 Real stumpage prices of sawlogs in Finland, 1920–1960 (Data source: Sivonen 1970)

By roundwood exports during the Korean boom Metsäliitto accumulated enough financing options to be able to buy Wärtsilä's pulp and paper mills at Äänekoski in Central Finland.

Metsäliitto was quite successful in its operations and in its mission until the end of the 1950s, when roundwood exports were its main business. Then, after a peak of such exports in 1960 and along with expanding processing capacity and increasing stumpage prices in the 1960s, Metsäliitto experienced some critical years of unprofitability but survived. Its membership has been recently around 130,000 non-industrial forest owners.

While Metsäliitto has gained experience in wood processing of multiple kinds, it has been helpful for the forest owners and their associations to learn more about the processing costs and profitability of the industry. This has somewhat eliminated the asymmetry of information availability among the sellers and buyers of roundwood.

4.3.6 Roundwood Market Institutions

Expanding demands for roundwood by the forest industries have dominated the real increase in stumpage prices, value of forests, and increasing stumpage and labor income in forestry from 1860 until 1960.

The utilization of forest resources in order to sustainably satisfy human wants by forestry goods and services relies primarily on successful formal institutions and on the proper functioning of the market system. Sawlogs in Finland experienced a real stumpage price trend growth of 1% per annum from 1860 to 1920 (Kunnas 1973). Thereafter, for nearly a half of a century the respective growth was 2.0% (Fig. 4.9).

This stumpage price increase facilitated even faster increase in the forestry incomes to forest-owner farmers and other rural people due to increasing industrial logging (Fig. 4.4). In fact, the net incomes for the farmers from forestry and agriculture were about equal during the 1920s–1930s (Laine 2004).

Photo 4.5 Felling a tree by two-man manual saw (*for big trees*) in the early twentieth century in Finland. Most logging took place during winter (Photo: Finnish Forest Research Institute)

Forests could also be used as collateral for credit since the laws of 1901 and 1929 in support of borrowing money. Also forests could be insured against fire by two insurance companies since 1916 (Helander 1949). This increased the financial importance of forests as a natural capital to the farmers.

Only a few private non-industrial forest holdings were large enough to alone support the level of living of the family owner. Forestry was most commonly run as a part of a farm during the first part of the twentieth century in Finland. Practically all the farms had more or less forest. Forestry management was based on natural forests with natural regeneration causing only minimal costs.

Subsequently, farm forests provided not only wood for household consumption but often also for sales. The income was generated partly as stumpage, and partly as logging work (Photos 4.5–4.8), extraction of logs by horses (Photo 4.3) to the closest watercourse, and floating the logs (Photos 4.1 and 4.2).

Photo 4.6 Bucking a tree by one-man manual saw of wooden frames, which was used for small trees. Work efficiency study is going on. Numerous saws in a stand waiting for testing (Photo: Finnish Forest Research Institute/Paavo Aro)

Photo 4.7 Bucking a tree with steel-framed manual saw in the 1950s (Photo: Finnish Forest Research Institute)

Photo 4.8 Debarking a log with a manual tool (petkele) (Photo: Finnish Forest Research Institute/Albert Sandman)

This was a fortunate rotation of work in agriculture during summer and fall, logging in the winter, and floating of logs during the spring. Accordingly, the ratio of capacity utilization of both human labor and horses became high. It was possible to complement agricultural income by forestry income in consumption and in investments to raise the productivity of agriculture.

This was especially important during the first decades of the twentieth century, when banking was still in its early development phase. Peasants and liberated tenants owned only small arable fields, which never alone could support their families. Thus, labor income from various forestry works was necessary for their survival. The same also applied to the numerous landless rural people (Vihola 2004).

The continuous increase of real stumpage price trends has reflected increasing values of forest stands and forest holdings. This has given an incentive and self-motivation for forest owners to avoid deforestation and forest degradation as well as to intensify forest management.

In Finland this "invisible hand" or Kuznets curve mechanism has been operational since the latter half of the nineteenth century. This was possible due to clear and strong forest property rights and increasing demand for forest products. This value creation was a driving force in terminating shifting cultivation until 1920 (Map 3.1; Box 3.4). The increased value of forests could also finance generation shifts of farms.

Markets have played key roles in raising the value of standing forests. Low-value forest resources and timbers are wasted still today in socialistic forestry countries, especially in the tropics (Chap. 5). High-value resources, on the other hand, are mostly sustainably managed and conserved. "Goldsmiths never waste their raw materials." In terms of economics, along with the increasing value of forests the social opportunity costs of sustainable forestry decrease and clearing of forests for farming will no longer be profitable (Palo 1997).

The most important body "The Central Association of Finnish Woodworking Industries" (Suomen Puunjalostusteollisuuden Keskusliitto ry) was established in 1918. It became highly influential in lobbying the government and the parliament for benefits for its members. A member of the Association was regularly invited to various government committees.

The new Association concentrated in the few first years on some key common interests, such as defending the right for industries to buy forest holdings from the farmers and resist new colonization law. Later, foreign trade issues were on the agenda. It also promoted joint research and development within the Finnish Pulp and Paper Research Institute (Keskuslaboratorio), which was established in 1916 and a couple of years later a professorship of wood chemistry at the Academy of Åbo.

During World War II the Association had special duties under the government control of forestry (Lindroos 1993). It was also a partner in collective roundwood agreements in the 1940s.

The efficient functioning of the roundwood market was essential to complement the forestry legislation. The buyers of industrial wood were mostly forest industry companies but also various roundwood exporters. As professionals they were better informed about the domestic and export prices and quality standards and had better mastered the scaling of non-geometric standing trees and roundwood. The sellers were mostly farmers, who engaged in roundwood sales occasionally and remained amateurs in this tricky trade.

The first specific law for roundwood scaling was launched by the parliament in 1936. It specified the ways of scaling logs and pulpwood, which had different methods. The more valuable sawlogs were scaled in English cubic feet one by one and the less valuable pulpwood in cubic meters as mass measurements in piles.

If disagreements occurred, the seller could appeal to an official scaler to solve the issue. If the dispute could not be solved in this way, a final solution was arrived at by a referee board of three professionals. The enforcement of the scaling law was given to the Forestry Board system (Laine 2006).

Farmers' Union MTK also supported the preparation of the law on roundwood scaling in the 1930s. During the next decade, MTK was a key body in the preparation of the law for Forest Management Associations. It was then also a partner in collective roundwood price agreements in negotiations with the buyers.

This is a good example that efficient market system may often require a framework of legislation. Fair scaling can be assumed to sustain the incomes of forest owners and raise the value of forest holding.

4.3.7 Export Market Institutions

In Finland exporting of forest products as well as other products has mostly during normal times been free from export duties and quotas since 1882. The Finnish exports faced, however, duties of the importing countries until liberalizing of world trade efforts during the last decades. Imports to Finland were regulated by rather heavy duties from 1918 until the 1960s, when Finland joined the European Free Trade Association. Some duties on imports remained even later (Kaukiainen 2006).

Finland had a plan over one century to remove poverty through social and economic legislation, by mutual agreements of the labor unions with the federations of employers, by the Farmers' Union MTK (since 1917), via agreements with the government, and so on. MTK established a specific unit for forest policy issues in 1927.

In 1942 the provincial bodies of Forest Management Associations proposed an independent Forestry Council to be established within MTK. This proposal was accepted. MTK was active in the interwar period in resisting duties for roundwood exports.

The forest industries had established various associations already towards the end of the nineteenth century. The Finnish pulp and paper industries exported their products mainly to Russia until Communist Revolution of 1917. In a new situation a number of new associations became established, e.g., Finncell, Finnpap, and Finnboard, primarily for joint marketing of various groups of forest products to the West.

Finland had until the end of the 1920s exported mainly sawnwood. Pulp exports increased in the following decades along with newsprint. In the 1950s both writing and printing papers, kraft papers, and paperboard exports increased rapidly. Later on, Finland gradually surpassed Sweden, Canada, and the United States in the share of these more value-added products in their exports (Peterson 2004).

4.3.8 Financial Market Institutions

The Finnish banking system was intensified during the latter part of the nineteenth century. There were only 23 local saving banks in 1860. Their number increased to 39 in 1870, when the first commercial bank was established. By 1900 nine commercial banks and 193 saving banks existed. By 1914, 410 local cooperative banks were established exceeding slightly the number of the saving banks. A few more

commercial banks appeared (Vartia and Ylä-Anttila 2003). In a similar way a number of insurance companies appeared. The system continuously expanded during the first part of the twentieth century.

Capital markets were protected in Finland until the middle of the 1980s. The Bank of Finland gave allowances for imports of foreign capital. Domestic banks and insurance companies favored investments in forest industries due to relatively few investment opportunities available in a small country and the high knowledge institutions of this industry in Finland. Consequently, for example, in the 1950s all pulp and paper machines were restored (Ollonqvist 1998) and several expansions took place.

4.3.9 Labor Market Institutions

The labor supply for forestry, floating, and forest industries was favorable in Finland until the 1950s. Due to a low degree of industrialization and centuries-old colonization activities by the government the rural areas had a high number of peasants, who needed additional work. Also numerous landless people were ready to migrate for part-time or full-time employment to the distant logging, floating, and mill sites. In a study of forestry labor in 1923 it was found that nearly two thirds of the labor force was composed of peasants and tenants and the rest of landless rural people (Helander 1949).

In the first decades of the twentieth century Finnish forestry demanded an increasing number of loggers and log floaters. In the late 1920s and in 1933 it was assessed as about 110,000 man-years and about 30,000 horse-years work input.

About two thirds of the laborers and horses worked in the farm forests and the rest in the state and corporation forests. The seasonal variation of the forestry work was strong. February was the high season with about 300,000 loggers while the low figures in August counted only about 15,000. The number of permanent forest workers remained low, about 700 in 1928 (Helander 1949).

Government interventions have also taken place in the forestry labor market. Some minimum requirements were set up by the law for housing of loggers in 1928. After the Great Depression of the early 1930s, an information system to follow-up loggers' wages was created by the government and later in 1964 a minimum wage control under a specific law by the Parliament was launched (Palo 1993).

The peak in forestry labor input was in the early 1950s (Fig. 4.7). It was estimated that 267,000 men worked a minimum of 11 days in forestry in 1950. This number decreased by 15% until 1961 and even faster after that under rapid mechanization of logging. However, the number of permanent forestry workers (more than 100 working days a year) increased from 70,000 to 90,000 in 1950–1961 (Heikinheimo et al. 1972).

Forestry work was highly seasonal, it was part-time work, and logging sites were small and distributed all over Finland. Under these conditions it was difficult to establish labor unions for forestry workers. Some unsuccessful unionization attempts were made during the first part of the twentieth century.

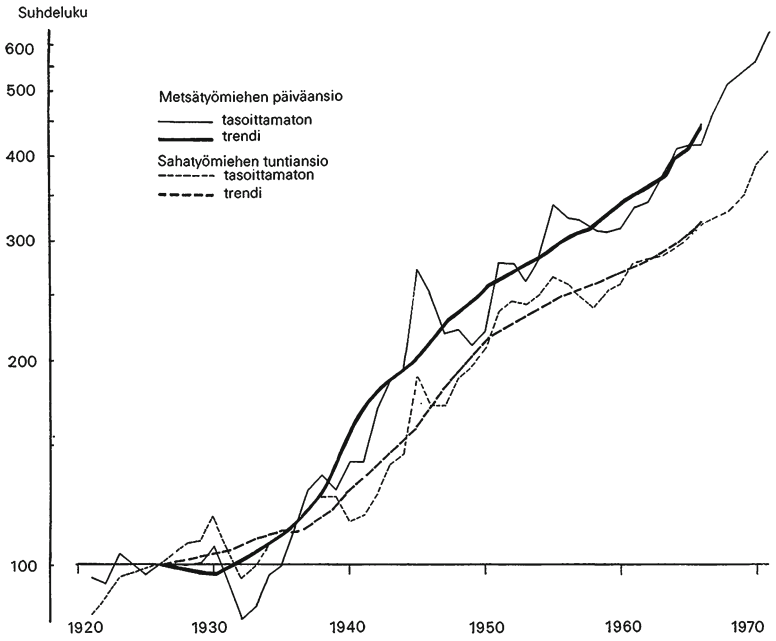

Fig. 4.10 Real wages of forestry workers (*higher graph lines*) and sawmill workers (*lower graph lines*) in Finland, 1920–1970 (Heikinheimo et al. 1972, p. 31)

The Union of Rural Workers (Maaseututyöväen Liitto) covered both forestry and agriculture and was active after World War II with no remarkable success. In spite of the weak union, the real wages of forestry workers rose in absolute terms and in relation to sawmill workers between 1920 and 1970 (Fig. 4.10).

The trade union movement in general was weak until World War II (Kujala 2006). There were local strikes but employers applied volunteer cadres to suppress such strikes. In January 1940, in the middle of the Winter War between Finland and Soviet Union, the Central Organization of the Trade Unions SAK and the Employers' Confederation TKL made an agreement, an "Engagement of January." TKL considered SAK as an equal partner in future collective agreements on wages and other terms of employment. One idea behind this change was to consolidate the Finnish society in support of the ongoing war.

The Union of Paper Mill Workers (Paperiliitto) made its first collective agreement in 1945. Since then these agreements were made rather regularly. The wages of the paper workers became gradually at the top among all the unions of SAK. The workers in the paper mills were concentrated in the mill sites. The contacts and delivery of information was relatively easy at the mill gates (Kujala 2006).

Paper mills were also becoming highly capital intensive, which made the strikes by the trade union quite costly for the employers. This provided much better conditions to create a strong trade union than among the loggers, who were able to establish the first collective agreement on wages by 1957 and a comprehensive agreement in 1963.

4.3.10 Community/NGO Institutions

Suomen Metsänhoitoyhdistys Tapio (Finnish Silvicultural Association Tapio) was established in 1907. Its mission was to promote silviculture among the farmer forest owners and to receive state subsidies for this end. The implementation of this mission was executed by establishing local Forest Management Associations, publishing, and extension. The Diet decided in 1898 to allocate some funding for silvicultural extension via provincial agricultural societies. Tapio adopted as one of its goals coordinating these activities. The Finnish Forest Association also forwarded its state subsidies to Tapio (Holopainen 1968; Viitala 2006).

Föreningen för Skogskultur (Association for Silviculture of Skogskultur) was created in 1912. It was Tapio's sister organization for Swedish-speaking farmer forest owners. Its financing was based on a donation by Herman Renlund, a wealthy businessman. The activities of the new society were similar to Tapio's. Later in 1928 both organizations were vested with semipublic status as Central Forestry Boards supervising the Law of Private Forestry (Helander 1949).

The Finnish Forest Association was active in all fronts of forest policies. It proposed in 1879 the establishment of a forest research institute. The proposal was repeated until the institute was finally created in 1917. In 1880 and repeatedly thereafter the Association proposed to the State Statistics Office the compilation of forestry statistics. The Association was given a chance to comment on various committee reports before the final approval of new laws and acts (Heikel 1927).

The Finnish Forest Association expanded its activities in 1925 by organizing a Forest Day meeting with public lectures and discussions on forestry issues. The following year this event lasted 4 days. It became an annual tradition attended by an increasing number of forestry professionals. The Association started to also organize forestry excursions with specific educational and recreational components. In 1941 the bylaws were changed so that the association became the central body for various existing forestry NGOs and trade unions (Makkonen 1977).

The first local Forest Management Associations were established in 1908. Their number increased from 86 to 310 during 1929–1939 partly due to the simultaneously increasing state subsidies. These Associations were then operating on a voluntary basis but they were important policy instruments to extend rational methods in marking trees for sale and for silviculture.

The Associations were expected to support sustained yield forestry by preventing further forest degradation. During 1898–1928 forestry extension had already been promoted on a small scale by local Agricultural Associations along with a few other NGOs with minor state subsidies as described above (e.g., Holopainen 1968; Viitala 2006).

The Great Land Reform was mostly executed by 1900. It defined all lands and forests to belong either to farmers or to the state. Only a fraction was left over as community forest. The case of Kälviä's community forest was a major exception (Box 3.11). For some time the problem of small farm forest holdings had been noted.

Hannes Gebhard was pioneering with the cooperative idea in Finland. It was believed to be a panacea in almost every field, including forestry. He first recommended in an article joint timber sales for farmers. Pellervo also became active in 1901 in forestry by launching model bylaws for both Forest Management Associations and for the joint timber sales agreements. This was assumed to complement the Forest Law of 1886 (Helander 1949).

4.3.11 Conclusion

Informal institutions have played a key role in the forest transition in Finland. Here we have reviewed the impacts of these causes in the order from the top left of Fig. 2.4: knowledge, corruption, markets, and community institutions. They all have had effective impacts and interactions on the forest transition. The markets have functioned most strongly in the absence of corruption.

Next we will review the formal institutions of property rights and state regulatory institutions, which have alone and in the interaction with informal institutions, ecology, inter-sector, and international impacts played certain roles in the forest transition in Finland from 1900 to 1960.

4.4 Formal Institutions

4.4.1 Introduction

The aim of this section is to review the underlying property institutions and other state institutions in de jure support of the transition of preindustrial forestry into sustainable industrial forestry in Finland from 1900 to 1960.

Knowledge, market, and community institutions and their players, along with the media are mostly engaged with the issues that appear on the agendas of the state institutions. These informal institutions, in fact, commonly raise issues into the political agendas. The players of the informal institutions in Finland have traditionally been invited to the committees for preparation of changes in the formal institutions.

Property rights and other state institutions comprise the formal institutions. The arena for the politics and policy formation is located in the parliament system as well as in the government and its administration. Political parties are the primary players in these arenas along with lobbying by various other bodies.

Industrial workers, landless rural people, and the tenant peasants were politically organized into the Social Democratic Party (Suomen Sosialidemokraattinen Puolue) in 1903. Soon an Agrarian Party (Maalaisliitto) also appeared to support the interests of farmers and peasants. Both parties grew as strong economic, social, and

political countervailing powers to the previous political powers of the nobles, the clergymen, the bourgeois, and the larger farmers. Some other smaller parties existed until 1918, such as the Conservative Finnish Party (Vanhasuomalainen puolue), the Liberal Finnish Party (Nuorsuomalainen puolue), and the Swedish Party (Svenska Folkpartiet).

4.4.2 Property Institutions: Privatization of Forests

The Senate gave a declaration in 1877 to give the Forest Service the power to decide which sites in the state forests were suitable for colonization. New farms were allowed to be established only in those identified locations, where they did not have detrimental impact on state forestry. Soon a lot of criticism arrived, especially from the estates of the farmers and the clergy at the Diet.

Accordingly, in 1886 a committee was established to reconsider colonization policies in the state forests. The 1892 Act by the Senate removed from the Forest Service the power of deciding on colonization in the state forests.

A two-stage administration was created in each province with a major amount of state forests to study the suitable locations for colonization and to make the final decision on this issue. In 1918 only 287 new farms with 54,000 ha of land became established. The system did not prove operational under conditions of increasing number of the rural landless poor (Helander 1949).

Freehold land was defined in the 1734 Swedish law as land that belongs to a family, and a farmer has a formal property right to the same land. The farmer may have inherited this land from his/her parents, children, sisters or brothers, or other relatives. In order to safeguard the larger family's rights this freehold land was not allowed to be sold or transferred as a gift or via last will and testament.

Under liberalism a revolutionary transformation in this law was made by the Diet in 1877. The inheritance right was restricted only to parents and children. This move opened the way for business to buy forest holdings at the time of rapidly increasing value of forest (Renvall 1915).

Kalle Kajander, a farmer and an author, made a tour to eastern Finland to study the sales of farms with their forests to forest industry corporations. In 1901 he published a book "Forests and Corporations" (Kajander 1901). It won a special prize from the Finnish Economic Association, partly due to the missing proposal of state regulation of this market.

The book described the recent expansion of corporate forest ownership. An increasing number of farmers had sold their holdings at low prices and stayed after the sale as tenants on their previous farms or emigrated to North America. Kajander proposed improved information and education to the farmers. The Senate set up immediately a committee to study the issue in more detail.

The committee gave various alternatives to solve the issue, but no ban on the acquisition of farms by corporations was proposed. This issue appeared before the Parliament in 1907 and the discussion continued there for 8 years. As a consequence,

the 1915 Act to restrict the acquisitions of farms by industrial corporations was launched. It was not, however, foolproof; corporations could circumvent it by establishing "shadow companies" without wood processing.

Heikki Renvall (1915) made a study of this social "hot potato" in order to support corporate ownership of forests. He analyzed the special features of forest holdings as a marketable commodity. Sustainable forestry required such a long planning period that its management fitted better for corporations of intergenerational character than to individuals with much shorter planning horizons.

A social interest here is that forests should produce the best socio-economic outcome. Two corollaries would meet this requirement: sustainable forestry and an ownership that would produce the highest value. The conclusion by Renvall (1915) was that forest industry corporations could manage forests much better than the farmers, and therefore they should have the right to buy forest holdings.

Under political pressure from the Agrarian Party and as a consequence of the civil war of 1918, the parliament amended the 1915 Act by Lex Pulkkinen in 1922 (confirmed by the President in 1924). The study by Renvall (1915) did not, after all, help the forest industry corporations to maintain their right to acquire forest holdings.

The corporations had achieved an ownership of about 7% of the total forest area. This share became frozen for nearly a century to come. Regulation continued in one form or another until 1998. Thereafter, the market for forest holdings became liberated again. Under the 1995 European Union regulations, even foreigners were allowed a free hand to acquire forest holdings in Finland.

In 1918, as another consequence of the civil war, the new "white" government of Finland made a radical land reform to liberate the tenant peasants in the private lands. As a rule they got their farming land and also a woodlot to suffice for home consumption of fuelwood and construction timber. Four years later tenant peasants farming in the state forests were liberated.

Another major land reform, Lex Kallio, was launched in 1922 in order to purchase land for the landless people. As a consequence of the three reforms together, about 150,000 new independent farms with their forests were created by 1935 (Holopainen 1968).

A Board of Colonization (Asutushallitus) was established in 1918. Since 1892 the allocation of state forests for colonization was decided by the Forest Service. The state foresters mostly considered small-scale farm forestry inferior to large-scale state forestry. Therefore, they were not particularly motivated to support expansion of colonization, although the issue of increasing poverty of the landless rural people was appearing more and more serious along with the advancement of the Great Land Reform.

Sustained yield forestry (Sect. 2.1) required a long intergenerational time perspective. Forest owners should be large enough to be able to hire professional foresters and rangers and enjoy the economies of scale in their operations. In all these respects the state was considered as the best forest owner and the forest industry corporation as the second best (Renvall 1915 never discussed the state as a forest owner). Farmers were considered the least capable as forest owners due to their inadequate knowledge of forestry.

Box 4.6 Traditional Reasoning in Support of the State Ownership of Forests

A committee for state forests gave its report (Valtionmetsäkomitean… 1920) to the government of Finland. The mission of the committee was to propose ways to organize the administration of the state forestry for implementing modern principles of silviculture. The committee defined the pros and cons of state forestry as follows.

The state is a superior forest owner due to its ability to practice rational forestry. This ability is based on its large-scale forests, its intergenerational planning horizon, no need to exploit forests due to casual financial crises, and its ability to hire professional foresters and forest rangers. All states have to borrow from banks, the more state forests, the more collateral for credit.

The more the state owns forests, the more liberal institutions are necessary for private forestry. The committee concluded finally that it perhaps would not be a happy situation that all forests belonged to the state. In such a case forestry might evolve too one-sided and involve too much bureaucracy. A bright deduction!

The committee also recorded some drawbacks to state forestry. In general, the state is not considered as an ideal agent to run a business, although some empirical evidence exists that the state can run forestry better than agriculture. Under state management it is difficult to pay according to the productivity of each employee. A small private forest owner may know better his forest than a state. He can perhaps also log more variety of wood assortments in his forest leaving less residues than the state.

The idea of the supremacy of the state as a forest owner in comparison with farmer or family ownership has survived in Finland, Sweden, New Zealand, and many other countries. Eino Saari (1929), Professor of Forest Policy and Viljo Holopainen (1956), Professor of Forest Products Marketing at the University of Helsinki, largely agreed with those positive aspects of state forestry without any critical points. Theoretical aspects of state property rights of forests were introduced in Sect. 2.5 of this book.

Only a few early critical voices were raised against the supremacy of state ownership of forests. A. Howard Grøn (1949), Professor of Forest Economics at the University of Agriculture in Copenhagen, Denmark, gave the following statement: "In countries where the idea of individual freedom prevails, state forest ownership should, however, be limited to forests of special common utility as protection forests, recreational forests in thickly populated tracts, and new forests created through the afforestation of waste land. State ownership for financial purposes, as common centuries ago, is today rather senseless."

In Finland this view was shared not only by state foresters but also by the most influential professors, A.K. Cajander (1921), Eino Saari (1929), Viljo Holopainen (1968). Most foresters adopted this view (Box 4.6). They did not pay attention to the favorable income distribution impacts due to the high number of farm forest owners (Gylfason 2001).

There also existed labor income effects from the numerous landless people working in forestry, and the efficient seasonal rotation of human labor and horsepower between farming and logging. The ample supply of labor for logging and floating was due to the active colonization of the remote forests. The professors were not aware of the serious pitfalls of socialistic forestry (Sects. 2.4 and 5.1).

The number of farms in 1917 in Finland was 120,000 and by 1945 the number more than doubled due to liberation of tenant peasants and active colonization of landless people. The additional land needed for this colonization was primarily taken from the state forests. The right of the companies to buy agricultural and forestry holdings was legally restricted. Therefore, private industrial forest ownership remained stable at the low level of 7% of the total forest area. As a consequence, the total forest area owned by the non-industrial private persons, primarily farmers and peasants, was increasing.

Private ownership of forests has also benefited both the state and the municipalities via forest taxation, which was based during 1921–1992 on the potential average yield of timber and market prices and on average costs, but both earlier and later of this period on real net income. The first national forest inventory in the early 1920s was launched primarily in order to create an objective basis for forest taxation.

Major land reforms of 1940 and 1945 due to the World War II were also enforced in Finland. More arable land and forests were allocated from the state, municipalities, the church, corporations, and manor estates to evacuated farmers from the eastern territories lost to the Soviet Union. Also soldiers and their widows had been promised new land during the wars.

A Law of Land Use was enacted by the parliament in 1958. Its aim was to replace the previous colonization laws and to provide guidelines for non-emergency activities in this front. From 1900 to 1958 about 2 million ha of state forests were allocated to the farmers. This new law facilitated nearly half a million hectares more between 1959 and 1965 (Holopainen 1968).

The share of forest ownership by farmers (non-industrial private forest owners) increased between 1922 and 1963 from 51% to 63% and the respective share by the state decreased accordingly from 40% to 28%. The share of the forest industry corporations remained for the whole period at 7%, while the municipalities and the church's parishes owned the residual of 2% (Holopainen 1968).

The land reforms not only provided employment and incomes for a high number of people but they also consolidated the Finnish democracy against a potential communist revolution, which was a threat after World War II. Farmers, even peasants, were not so sensitive to communist propaganda as were the workers.

From 1918 to 1998 the government regulated forest holding ownership in favor of farmers and peasants in order to prevent the expansion of corporate forest ownership. This farmer-owner pattern of tenure has been important for socially and economically sustainable development, because of fair distribution of forestry incomes both functionally and spatially in comparison with primarily state ownership, which largely prevails today in the tropics (Sects. 2.5 and 5.1).

4.4.3 State Forest Service Institutions

A first step of *de jure* sustained yield forestry arrived in the form of the new forestry law of 1886, although the 1647 and 1734 laws already had some elements of sustainability (Tasanen 2004).

The 1886 law declared simply that deforestation was not allowed (Box 3.15). It was preceded by some important laws and acts, such as the Great Land Reform (Isojako) of 1757, State Forest Service in 1851 and 1859, and the College of Forestry in 1858.

A new act on the state Forest Service was launched after the Director-General P.W. Hannikainen had been working for some years (Armollinen asetus… 1908). It stated that the Forest Service is expected to execute the following tasks:

- Manage the Finnish state forests and enforce regular forestry ("järjestetty metsätalous") in those forests,
- Control also carefully the private forestry and propose to the Senate instruments that may be needed to promote forestry,
  - To overview the forestry schools,
  - To overview the activities of the staff of the Forest Service,
  - To account the revenues and the expenditures and keep the books,
  - To report annually,
  - To control hunting and fishing in the state forests,
  - To give opinions and reports on actual issues,
  - To obey the orders by the Senate.

Some new duties were specified for the Forest Service in a more specific regulation by the Senate. The Forest Service had to support silviculture in various disputes concerning the state forests. Furthermore, it had to complement the stock of maps, to study the productivity of the forests, and to prepare management plans and execute their follow-ups from time to time (Keisarillisen… 1908).

It was interesting again that no specification about sustainable forestry for the management of state forests was given in these acts!

When A.K. Cajander, Professor of Silviculture, was nominated as the Director-General of the Forest Service, a new reform occurred. The 1921 Act on the Forest Service expressed its general task to manage, oversee and, promote forestry in Finland. The specific task on state forests was expressed as to manage, administrate and direct state forestry and state wood processing. A duty to oversee, control, and promote private forestry was also specified by this act. But again, no sustainability specification was given!

4.4.4 Private Forestry Institutions

It was interesting that the 1917 Forest Act and the establishment of the Forest Research Institute took place just before 6 December 1917, when the Parliament declared the ultimate sovereignty for Finland (Fig. 4.8).

The 1917 Forest Act concerned only private forests. It expressed both prevention of deforestation and forest degradation. Deforestation was not allowed. After clear-cutting a natural regeneration of forest had to be enforced. The cut of young coniferous forests was allowed only by appropriate thinning and not by clear-felling. The act was a prohibition. No positive statement of a goal towards sustainable forestry was expressed. This situation prevailed in private forestry until 1996!

The enforcement of this act was delegated to a new state body of Provincial Forestry Boards while the forestry extension was already dedicated earlier to Provincial Agricultural Associations. Their activities were coordinated by Tapio. The Board of Agriculture supervised the forestry extension activities. In 1921 the Forest Service was given the supreme power of the supervision of the 1917 Act enforcement (Box 4.7).

Box 4.7 The 1917 Act on Prevention of Deforestation in the Private Forests (Asetus toimenpiteistä… 1917)

The Act was passed by the intermediate Finnish Government on 2 November 1917, only 34 days before the final independence of Finland. The Act replaced §14 of the 1886 Forest Law. Therefore, it covered only private forests. The Act was divided into five parts as follows: deforestation and its consequences, enforcement, provincial and municipal forestry boards, violating this Act and confiscation, and finally some other aspects. The act is briefly summarized here and translated from Finnish into English by the author.

Part I Deforestation and its consequences

§1 Deforestation is not allowed; forest should not be felled in such a way that natural regeneration of forest would be endangered. Deforestation concerns also cases, where young productive coniferous forest is not felled according to rational thinning.

§2 If felling is done according to a periodic plan approved by the Provincial Forest Board of §6, it is not considered as deforestation provided that a collateral for regeneration has been deposited for the Provincial Forest Board.

No deforestation occurs in cases of clear-felling for gardening, farming, construction, storage house, or a meadow for own use.

§3 If deforestation has taken place, the forest holding in total or partially should be protected (logging banned). Also actions should be taken to ensure reforestation. Protection refers to a ban of felling or forest site or both with or without restrictions. The conditions of each case define the scale and timing of protection. Household use of wood and grazing of forest should not be banned, if reforestation will not request it.

§4 The order of forest protection is determined by the sub-court of the location of the forest holding. The Provincial Forest Board has, however, the power to provisionally protect the forest holding in a scale

(continued)

Box 4.7 (continued)

determined by the deforestation case and the prevention of a continuous deforestation. This kind of protection will be valid until the agreement of §10 is done or the court rules otherwise.

§5 The Provincial Forest Board should take care of reforestation. The Board may leave the implementation of reforestation to the owner of the forest holding, whenever positive outcome looks likely.

Part II Enforcement of this Act

§6 The Provincial Forest Board shall enforce this Act supported by other civil servants.

§7 If the forest owner has sold the felling right to somebody, he/she has to inform in writing the site of felling, its scale, the conditions, and schedule of felling to the Municipal Forest Board of §18. If the forest owner himself will fell trees for sale or for selling processed wood products, he should make a similar notice. There is no obligation to notice, if the felling will be carried out according to the approved plan, or if the forest owner himself will fell forest by applying rational thinning. The Municipal Forest Board has to forward the advance felling notices to the Provincial Forest Board.

§8 When it is likely that deforestation has occurred or that the approved felling plan or the orders of protection have been violated, the Provincial Forest Board has to make a field inspection. It should be executed by a forester or forest ranger employed by the Board along with two members of the local Municipal Forest Board.

§9 The inspection report has to be made in writing. If it should contain any violations of §8, they have to be specified in the report along with a statement by the members of the need and scale of protection, of the potential actions for reforestation and of inherent costs.

§10 If the Provincial Forest Board, based on the field inspection, observes that deforestation has occurred, it has to make an agreement in writing with the forest owner or with the owner of the felling right or with both of them on protection of the forest and safeguarding reforestation. If no agreement can be done or if the approved plan or the protection orders have been violated, the Board has to inform the court.

§11 The forest owner, the owner of the felling right or the supervisor of the felling has to be informed about the forthcoming field inspection whenever this can be done without extra delay.

Part III concerned the composition of the Provincial Forest Boards and the Municipal Forest Boards, Part IV violation of this act and confiscation and Part V other issues. They have been excluded from this translation.

Box 4.8 Cajander, Pekkala, and Random Factors in Support of the 1928 Law

Dr. A.K. Cajander was a man with personal power. Primarily he had been nominated as a Professor of Silviculture at the University in 1908 until 1934. In 1914 he became an acting Professor of Forest Mensuration until 1928. Then in 1918 he became nominated as the Director of the Forest Service. While in office, he also chaired the Board of the Forest Research Institute until 1928. He was a member of a political party – the Progressive Party (Edistyspuolue).

In 1922 Cajander was nominated as a Prime Minister of the Cabinet. In this duty he still supervised the theses by the graduate students. Professor N.A. Osara told me that he received the theme of his master's thesis from Professor Cajander at the office of the Prime Minister in 1922!

As a Prime Minister Cajander also took the position of Assistant Minister of Agriculture, which covered forestry. In this position he established a committee on private forestry. He invited Mauno Pekkala as a secretary of the committee. Pekkala was a forester, a department chief of the Forest Service, and a member of the Social Democratic Party.

The committee report was completed in 1926. Next year Mauno Pekkala was the Minister of Agriculture under a social democratic government of Väinö Tanner. This government proposed a new law for private forestry, which was opposed by most of the Farmers' Party, by the Farmers' union MTK, and the Provincial Agricultural Associations. The Parliament approved the law by a vote of 101–70 in 1928 (the maximum is 200 votes).

It has been argued that a couple of random factors caused the reform of the 1917 Private Forestry Act. First it was a kind of randomness that Cajander became a Prime Minister and was able to adopt the vacancy of a "Minister of Forestry." Another kind of randomness was that Pekkala became a Minister of Agriculture in 1927 to follow up the committee report, which he as the secretary of the committee had lately written.

Väinö Tanner as a simultaneous Prime Minister happened to also be a big forest owner and therefore motivated to promote forestry. The next government had by chance Mr. Niukkanen as a Minister of Agriculture. He had also been a member of the forestry committee. During this government the parliament finally approved the law in 1928 (Vaara 1990).

In 1928 four new forestry laws were launched by the Social Democratic government of Dr. Väinö Tanner, who was a big forest owner himself. Mauno Pekkala, a forester, as the Minister of Agriculture and a member of the Parliament, was another key person to facilitate such a radical reform of forest legislation. Among the new laws were the private forest law, another law defining its administration, a law on state subsidies for drainage and reforestation, and a law on housing of loggers and timber floaters (Box 4.8; Fig. 4.8).

The contents of the 1917 Private Forest Act were maintained otherwise the same in the new private forest law but it was expanded from the previous restriction to coniferous forests to also cover non-coniferous forests. Also forestry extension was included among the tasks of the administration along with the law enforcement.

The enforcement organization was changed in 1928 from a pure state one of the 1917 Act to a semipublic one on a provincial participatory principle. Each District Forestry Board was composed of the representatives of local forest owners. Each Board was composed of 3–5 local members acquainted with silviculture and an equal number of deputies. One member was nominated by the relevant Central Forestry Board and the other members by the provincial Agricultural Societies (Valtioneuvoston… 1928).

The mission of the District Forestry Boards was determined to include the promotion of private forestry by providing guidelines and controlling the local Forest Management Associations and by extension of individual forest owners, and enforcing the 1928 Law of Private Forest as well as some other duties. The Board employed one or a few foresters, forest rangers, and other staff to enforce the mission of the Board (Valtioneuvoston… 1928).

This organizational solution was unique to Finland. It has been viewed as an autonomous forestry administration by farmer forest owners or by persons, who were the objects of the law enforcement. The professional foresters were only secretaries and consultants to the members of the Boards. This was an early application of participatory management from today's point of view. The integration of law enforcement and extension was a novel solution in comparison with the 1917 Act.

The foresters had, however, expert power over the laymen members and to some extent they could strongly steer the decisions by the Board. The foresters could co-opt the members and in that way lead the activities of the Board. The co-opted Board members were expected to extend their views to their fellow farmer forest owners. This kind of criticism has been introduced (Vaara 1990).

Sixteen District Forestry Boards and one Central Forestry Association (Tapio) for the Finnish-speaking parts and two District Boards and one Central Forestry Association (Skogskultur) for the Swedish-speaking parts of Finland were established. Their activities were subordinated under the State Forest Service and the Ministry of Agriculture.

Also in 1928 a new kind of policy instrument, a carrot along the stick, was activated: state subsidies for forestry investments on a cost-sharing basis for private and state forest owners for increasing wood production. This kind of funding for the state forests continued until 1953 and was allocated for forest drainage and planting of spruce only. A parallel organization of 14 Forest Improvement Districts (Metsänparannuspiirit) along with the Provincial Forestry Boards was created under the supervision of the two Central Forestry Associations (Laki N:o 140/1928).

One third of the land area in Finland is composed of peatlands – both open bogs and moors forested by pines, spruces, or birches or their various combinations. The productivity of the forested peatlands could be raised by draining, which would lower the water surface and increase the oxygen in the soil water.

The Forest Service employed the first two foresters for drainage of peatlands in 1908. Their number was increased to five in 1913 and to six in 1917. During this period 42,000 ha were drained and 157,000 ha were prospected. The new

1928 law expanded the drainage activity on the state lands and mobilized it in the private forests.

The 1928 laws were amended several times during the following decades but their basic contents remained the same until 1996 (Fig. 4.8). The Tanner government launched also in 1928 a radical law to improve the low-standard housing conditions for the loggers and timber floaters in mostly remote logging camps. This law was amended in 1947.

The Forest Management Association Act of 1950 was the last important successive legislation in supporting the *de jure* transition to sustained yield forestry. The purpose of the new law was to tax the private forest owners in order to provide them earmarked financing of extension services by forestry professionals employed in forest management and in timber sales within these now law-based local Associations. The Associations received a new public financing channel and a semipublic status under supervision of the provincial Forestry Boards.

The law allowed a maximum of 6% of the taxable forestry income to be collected by the internal revenue office as fees for the associations. Towards the end of the 1960s the fee remained at about 3% as an average for the whole country.

The 1917 Forest Act banned deforestation. This aimed to prevent a decrease of forest area, which is regarded as the weakest criterion of sustained yield forestry. The act did not limit the scale of mature timber logging and in this respect there was no guarantee for sustainable logging. The act also regulated logging of young coniferous forest and in this way was partly supporting also the maintenance of the growing stock and future felling options and preventing forest degradation (Saari 1962).

The 1928 Private Forest Law also covered non-coniferous forests but did not change the basic contents of the 1917 Act. Another law of 1928 on drainage and reforestation even supported the idea of progressive forestry. The 1950 Law on Forest Management Associations was important in connecting the Associations with the Provincial Forestry Boards and in giving additional support for the Boards in local forestry extension work. The forestry knowledge institution was expanded.

4.4.5 Forestry Work, Forest Protection, Industrialization

A Committee on the Forestry Workers Occupational Training worked from 1952 to 1958 as a symptom of major future changes in logging and floating. It proposed that seven schools be established for this kind of training. One of them would deal with training for mechanization of logging. The implementation of these proposals started in 1962 (Holopainen 1968).

This was a burgeoning revolution in forestry work in Finland. Until then forestry jobs had been seasonal and carried out with traditional tools by crofters, farmers, and landless people without special training. Now, gradually, professional full-time workers appeared for the Forest Service and corporations.

Nature conservation (1922, 1938, 1956; Box 4.9), colonization (1918, 1922, 1935, 1940, 1945, 1958), and many other aspects of forestry and land use have been safeguarded by legislation since the independence of Finland in 1917 (Fig. 4.8).

Box 4.9 Evolution of Forest Protection in 1802–1956 (Laitakari 1960; Helander 1949)

In 1880 A.E. Nordenskiöld, who later discovered the Northeast Passage in the Arctic Ocean, raised the issue of nature protection on discussion agenda in Finland. He was aware of the similar proposals a few years earlier by G.P. Marsh in the United States, where Yosemite (1864) and Yellowstone (1872) National Parks had already been established. The Finnish Forest Association held further discussions on this theme and a number of other mostly scientific societies joined the proposal. They established a committee to prepare the case.

The Committee on State Forests proposed the establishment of protection forests in the fell areas in 1900. Finally the Senate set a committee, which made its report in 1910. It proposed the mountains of Pallastunturi and Pyhätunturi north of the Arctic Circle along with parts of Kuusamo in the northeast to be protected.

Finally in 1923 the first Law on Nature Protection was launched by the parliament. According to the law the President can decide new national parks and nature parks proposed by the parliament. Such beautiful areas should be located on state land and their nature should be preserved from human intervention. Protection could also focus to preserve certain wild animals or plants.

Several years passed, however, in the preparation of proposals for the new national parks. Even a specific tree, group of trees, or a monument of nature could be protected under this new law. A new vacancy for supervising nature protection was established at the Forest Research Institute, which later became the manager of the new nature protection areas.

The Forest Service invited in 1927 Professor of Botany Kaarlo Linkola to make a proposal for protected forests and other areas. His proposal was sent by the Forest Service to the government, which forwarded it to the Parliament in 1928. The Supreme Court stopped this action.

In 1930 a state committee was established to make a new proposal, which was ready next year. After various stages the new law was approved in 1938 with ten new nature protection areas. Half were lost to the Soviet Union after World War II. These areas were protected due to their aesthetic, ethical, social, or natural science-based reasons. The nature protection areas are preserved without human intervention or only modified in order to preserve their natural beauty.

The Forest Service established in 1955 a number of special forests where logging was excluded or restricted. The grouping was as follows: ten new nature parks and seven new national parks – a total of 127,000 ha of land and 2,500 ha of waters, also fully protected old growth forests (aarnialueet) – a total of 114 areas and 7,700 ha including ten protected nature monuments, park forests with restricted logging – a total of 74,000 ha, 46 areas of research forests – a total of 900 ha.

(continued)

Box 4.9 (continued)

Photo 4.9 A view on a timberline along a fell in Northern Finland (Photo: Erkki Oksanen)

The new Law of 1956 and the respective Act of 1958 confirmed the establishment of the nature parks and national parks above. It was based on a committee report of 1952. Laitakari (1960) concludes in his one-century history of the Forest Service that by now the seed sown by A.E. Nordenskiöld 80 years before had developed into a wealthy tree. He continued that in 1923 a beautiful price had been arrived at but it took another 30 years before the aims of the 1923 law became fully realized.

There was another early line in forest conservation in Finland. The shelter forests were conserved in order to prevent the descent of the timberline and forest frontier in the northern fells (Photo 4.9) or in the outer islands of the seas. The management of these forests was allowed in order to sustain the life of these forests and to prevent their decline. The aim is to satisfy primarily the local household demands for wood. If reforestation can be safeguarded, logging for sales of timber can also take place to some degree.

A committee report of 1910 observed the risk for the decline of the timberline in the northern fells and suggested a shelter zone of 30–50 km below of

(continued)

Box 4.9 (continued)

the present northern limit of the coniferous forest. A specific committee for this issue was set up in 1917.

The committee made its report after 3 years. It proposed a wide shelter forest zone of 3 million ha in the most northern part of Finland. The zone belonged primarily to the state. No specific proposals were made on the use of forests. In 1919 and in 1921 two studies on shelter forests were completed. Finally, in 1922 a law and 5 years later an act on the shelter forests was launched with certain restrictions in the management.

A commission for promotion of industrialization in its report to the government in 1951 recommended expanding investments in forest industries and those metal and machine industries with close linkages to the forest industries. In addition the recommendations included support by economic and financial policies for maintaining the technological competitiveness of the paper and paperboard industries (Ollonqvist 1998).

An Economic Policy Council was established in 1951 for strategic planning of public economic policy. The Council had members not only from the government but also from the unions of the employers and employees. It continued in one form or another to guide the economic policy through the 1950s and even until today. The Council has been supported by a team of professional economists as its secretariat.

In line with the paradigm change in economic policy a Commission for Planning Forestry was established. It was in session all through the 1950s. Its report was a landmark towards progressive forestry via increasing investments in intensification of forestry management, which started a new epoch in industrial forestry in the 1960s (Heikinheimo and Palo 1972).

4.4.6 Conclusion

The formal institutions were composed of property rights and other formal institutions of state forestry, private forestry, forestry work, nature conservation, and industrialization. Privatization of the state forests was continued between 1900 and 1960 as centuries before. Forest management and logging were gradually integrated with improving profitability in the state forests. State regulation of private forestry was expanded during the period. Accordingly, by 1950 *de jure* formal institutions to support forest transition were well established.

Next we shall turn to the *enforcement* of the formal institutions underlying forest transition.

4.5 Enforcement of Institutions

4.5.1 Introduction

The aim of this section is to describe the enforcement of the underlying formal institutions supporting forest transition from preindustrial forestry to sustainable industrial forestry in Finland from 1900 to 1960.

It is rather exciting to realize the appearance of numerous government laws and acts in order to regulate forestry since the fourteenth century that follow closely the socio-economic development. However, for centuries the enforcement of these laws was not effective, although various forestry administrations were created (Box 3.9).

Toward the end of the nineteenth century it was realized that the police corps under the leadership of the provincial governors were not able to effectively enforce the forestry law of 1886 (Helander 1949; Laitakari 1960).

Three successive committees were set up to redress this law. However, under the prevailing unstable political circumstances in the Russian Empire it was not before 1917 that the new Forest Act and its enforcement administration of state foresters and municipal forestry boards to regulate private forestry were created (Box 4.7).

4.5.2 Enforcement of the 1917 Forest Act

The 1917 Private Forest Act was a landmark among the numerous forestry acts until that time, because the enforcement of the act became effective. The act ordered each commercial logging plan to be reported to the local Board prior to logging.

If the act was violated according to the judgment of the provincial state forester supervising the implementation, the forester could negotiate a voluntary banning of future logging for a certain period by the forest owner. If this did not work, the case was taken to a court. The outcome could be banning of logging for a certain period and an obligation to carry out regeneration of the forest.

The effectiveness of the implementation of the 1917 act is supported by the facts that in 1919, the first year of its enforcement, logging was banned in 6,000 ha, from 1920 to 1924 another 15,000 to 27,000 ha, and in the last year, 1929, 73,000 ha of forests. Another requirement in the case of banning was a compulsory planting or sowing of the deforested site. However, only minor implementations in this front took place due to the scarcity of the staff (Helander 1949). The growing stock was increasing in the 1920s (Fig. 4.2), not due to increasing increment but because the drain was lower than the increment (Fig. 4.3).

The enforcement of the 1917 Act and its successor acts was handicapped by the lack of valid and reliable indicators of deforestation. Such felling was banned by the Act, which risked natural reforestation. How many seedlings, in what time, and of which tree species were questions to be judged in the field inspection. What kind of

forest was young, and therefore to be managed only by rational thinning? There appeared a number of open questions in the enforcement. It had a corollary that the criteria for the enforcement varied by the 11 provinces and the farm forest owners were not equally supervised (Helander 1949).

4.5.3 Enforcement of the 1928 and 1950 Laws

The new District Forestry Boards of the 1928 Private Forest Law employed 50 foresters and 180 local forest rangers by the end of the 1930s. This staff used most of its time in various forestry extension activities and only one third in the enforcement of the Private Forest Law of 1928 (Box 4.10).

Still the staff for the enforcement of the law was numerous in comparison with the staff implementing the 1917 act. Accordingly, the areas of banned forests increased considerably from the 1920s. About 0.4 million ha of forests were annually banned between 1930 and 1959 (Fig. 4.11). The peak was in 1940. Thereafter there appeared a continuous decrease in banned forest area. The growing stock was still increasing between 1930 and 1955 but leveled off in the late 1950s (Fig. 4.2).

Box 4.10 Evolution of Forestry Administration, 1900–1960

Administration of state forestry

The number of staff in the Forest Service inherited from the nineteenth century gradually increased with increasing activities in logging and in forestry education. The number of National Forests was 87 in 1918.

Also works in other fields increased. By 1918 inspectors of forestry numbered 14, inventory foresters 13, foresters specialized in peatland drainage 6, 8 foresters inspected the forests of the parishes, 4 foresters made management planning for the forests of military residences, 11 foresters were engaged in forestry education, and 8 foresters in sawmilling by the state.

After 1918 many changes took place in the organization of the Forest Service but its basic mission remained nearly the same, except that no more duties in private forestry or in forestry education remained. The former was transited to the Ministry of Agriculture and Forestry and the latter to the Board of Education under the Ministry of Education.

When the Board of Survey and Forestry was established in 1851, it was subordinated under the College of the Finance (finanssitoimituskunta). In 1869 the Forest Service was subordinated under the College of Agriculture (maataloustoimituskunta). Then in 1888 a change in this respect was made again. The forestry issues were transferred to the College of the Chamber (kamaritoimituskunta). In 1918 a final change took place. Forestry issues were subordinated under the Ministry of Agriculture (since 1972 Ministry of Agriculture and Forestry).

(continued)

Box 4.10 (continued)

Administration of private forestry

The Forest Law of 1886 was enforced for private forestry (paragraph 14) by the Provincial Governors and the police corps. The civil courts had the final say concerning the cases of deforestation and proposed logging ban. This system did not prove effective.

A pure state administration for private forestry was created by the Private Forest Act of 1917 (Box 4.7). This administration was composed of provincial foresters, their assistant foresters, provincial forestry boards, and municipal forestry boards. Its mission was to enforce this act. Extension was carried out by the Agricultural Societies. This system was effective but for political reasons a renewal arrived soon.

A system of two Central Forestry Boards (Tapio for the Finnish-speaking and Skogskultur for the Swedish-speaking districts) and 18 District Forestry Boards was created in 1928. They enforced the Private Forest Law of 1928. The District Forestry Boards were semiofficial, autonomous bodies with 3–5 members, who were appointed primarily by the agricultural societies. However, the Central Forestry Boards were allowed to nominate one member each. The Municipal Forestry Boards of 1917 survived. Similarly, the civil courts had the final say concerning logging bans.

The Central Forestry Boards were established as NGOs in 1907 and 1912. The Forest Amelioration Law of 1928 was enforced by the same Central Forestry Boards but with another district organization, which was specialized in drainage of peatlands, afforestation, and other future amelioration activities (road construction, prescribed burning, pruning, etc.). The whole system was financed primarily by the state and was under the supervision of the Forest Service, which had to establish a Department of Private Forestry in 1922.

This system of the private forestry survived with some modifications until 1996. The Law of Forest Management Associations of 1950 transformed the previous NGOs into semiofficial bodies based partly on earmarked tax paid by the forest owners. Along with a few minor amendments of the laws, a major change took place in 1986 with the fusion of the forest amelioration districts into the District Forest Boards.

A number of foresters and forest rangers were also recruited by the 1928 Forest Improvement Districts, which can be regarded as an instrument to support progressive forestry. In 1948 the design and construction of logging roads was added under this law. Forest drainage was expanded to 0.08 million ha in 1939 and a total of 0.72 million ha were drained during the 1930s. After the wartime interruptions drainage works were gradually expanded in the 1950s to 0.12 million ha in 1959 (Helander 1949; Holopainen 1968).

The number of forest rangers employed by the Forest Management Associations increased from 372 in 1950 to 715 in 1956. Even most of the Associations during

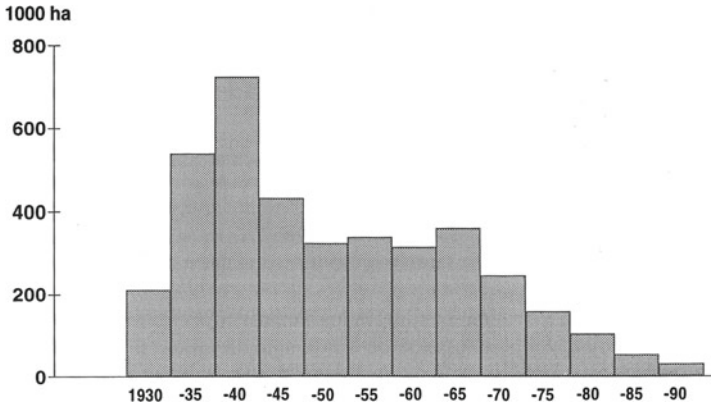

Fig. 4.11 The forest area banned by law in Finland, 1930–1990 (Hellström 1993, p. 179. Data source: Tapio 1992)

the same period employed foremen to support the activities of the rangers. The new financial options to recruit so many professionals to support forestry extension for farmer forest owners were a considerable new policy instrument for the District Forestry Boards (Viitala 2006).

A conflict between traditional and "scientific" forest management in the twentieth century was observed by Siiskonen (2007). The farmers had widely adopted the practice of "creaming" the largest trees or thinning top down, while "scientific" management recommended thinning bottom up. The latter meant the cutting of the smallest sized trees in the thinning, aiming for standwise regeneration (Box 4.4), while the traditional approach relied on treewise regeneration. This dilemma continued as a serious conflict with a lot of publicity until the early 1980s.

This conflict between farmers and foresters was a kind of counterpart of the "forest war" of the nineteenth century along with closing off access of local people to the state forests by foresters (Sect. 3.6). Another "war" took place in the early twentieth century between farmers and the industrial corporations concerning forest ownership (Sect. 4.3). The local people lost their traditional access for logging, shifting cultivation, and tar distillation in the state forests. Afterwards, the farmers won the corporations in forest ownership issue, but later on they lost their "war" against foresters concerning the felling practices.

The Private Forest Law of 1928 and its enforcement created a serious problem of subjectivity in the enforcement and inequality among the farmer forest owners. The District Forestry Boards gradually started to require marking of trees before logging by a forester, forest ranger, or a foreman. When a deforestation issue appeared the forest owner was asked for a voluntary contract for partial banning of logging. If no agreement was reached, no marking of trees by the forestry expert was allowed. Therefore only 3% of the cases were taken to the courts (Viitala 2004; Vaara 2010).

The District Forestry Boards were enforcing the 1928 law, practicing forestry extension, making forest management planning, and producing seedlings in their

own nurseries. This combination of missions to a semipublic body favored artificial regeneration of forests at the cost of natural regeneration, although the law gave priority to natural regeneration until 1967 (Vaara 2010).

4.5.4 Enforcement of Institutions of State Forests

The Senate decided in 1902 that the Forest Service would be responsible for providing the sleepers and fuelwood demanded by the State Railways. This was the beginning of logging by the Forest Service. Earlier the Forest Service had sold its timber mainly as stumpage sales or as concessions. Hannikainen, the Director-General, also expanded the delivery sales of sawlogs up to the creeks or to the gates of sawmills, which increased the demand for supervising logging and floating. In 1903 these delivery sales were executed in 13 National Forests and in 1910 in 32 National Forests.

Hannikainen established in 1905 four more Forest Ranger Schools. For the management of the state forests the increasing number of forest rangers was essential to support the work of the foresters. The Forest Service established sawmills at Siuro, next to Tampere, in 1905, and bought Kevätniemi sawmill beyond Joensuu in 1909 and another one in the same year at Sukeva beyond Kuopio. In this way more value added was created and profitability of the Forest Service improved (Laitakari 1960).

Cajander as the Director-General after Hannikainen promoted further processing of wood by the Forest Service in the 1920s. The capacities of the three existing sawmills under the Forest Service were expanded. A large new sawmill and a sulfite pulp mill were established in Kemi at the northmost end of the Gulf of Bothnia. Later, in 1932, they were reorganized as a joint public stock company, Veitsiluoto Oy. They became separated from the Forest Service. Cajander also supported expanding exports of roundwood by the Forest Service. The idea underlying these measures was to raise the stumpage prices and revenues of roundwood sales by promoting demand for roundwood.

Cajander also wanted to raise the level of silviculture and forest management intensification in the state forests. However, the progress in this front was slow. Drainage of peatlands had started in 1908. The number of drainage specialists was gradually increased and more funding was received under the new law of 1928. Two years later a specific department was established at the Forest Service to take care of this activity. Drainage was done by manual tools until 1950. Accordingly, it was labor-intensive activity. After 1950 exploding and plowing of ditches were adopted as more efficient methods (Laitakari 1960).

Professor N.A. Osara was nominated as the Director-General of the Forest Service in 1952. He became well known by implementing the large-scale clear-felling plans in northern Finland. He was also strongly against further colonization and privatization of the state forests. He promoted profitability in logging and also in drainage of peatlands for tree growth. Beginning in 1952 he chaired a committee on reforming the Forest Service, which gave its report in 1959. It contained a

revolutionary proposal to transform the Service into a public business enterprise and to transfer its finances outside the regular budget system of the state. However, this proposal was never adopted (Laitakari 1960).

4.5.5 Survival of the Finnish Democracy

The Finnish democratic system also survived happily through the difficult times of 1918, the early 1930s, and World War II. The Winter War against the Soviet Union in 1939–1940 was highly critical. Finland defended itself alone against the Soviet Union's massive attack. Large forests and cold winter benefitted Finland's army (Box 4.11). Finland never was occupied by the enemies during 1939–1945. The years after the wars were especially risky for a communist coup.

Box 4.11 Forests in the Winter War: The Strongest Barricade of Defense Against Soviet Union

The Soviet Union attacked Finland on 30 November 1939. A nation of 130 million people mobilized its army against four million Finns. Stalin (Molotov) and Hitler (Ribbentrop) had agreed in 23 August 1939 to conquer the eastern European countries. Germany and the Soviet Union already had divided Poland among themselves in September. Now the Soviet Union had made a plan to occupy Finland in 3 weeks. The Soviet army never made it. Why? In this box only the surprising role of forests in the defense of Finland is described.

The battles of the Winter War took place on the Karelian Isthmus between the Lake Ladoga and the Gulf of Finland and between the Lake Ladoga and the Arctic Ocean – the border was 1,200 km long. The isthmus had more agricultural lands, industries, and roads than the northern border, which was covered by endless forests with a few roads. Forests played their role also in the Isthmus but their role was decisive on the northern front. How could forests be the strongest barricade of defense to Finland and a disaster to the Soviet Union?

Finland had then the highest forest cover in Europe and has it still today (Map 1.1). Just about all the Finns could cross-country ski. The solders had been provided with white gowns to protect them against air raids in the snow. They also had practical tents with heating facilities.

More than half of the Finns still worked in agriculture and forestry. They had become used to work outdoors and in forestry even during the winter. Orienteering, lighting a fire, eating and sleeping overnight in the forest were familiar activities to most of the Finnish solders. A fair share of them were also experienced in extracting logs by horse and sled in the forest during winter.

(continued)

Box 4.11 (continued)

A contrasting situation prevailed among the Soviet soldiers. Many of them arrived from Ukraine or other non-forested localities. They could not ski. The Soviet army was advanced in motor vehicles of all kinds including tanks. This army was capable of operating only along roads. The number of horses was limited. No snow gowns were available. They were also missing warm clothing and workable tents. The Soviet soldiers were afraid of forest and often tried to get rid of the trees by cutting open zones along the roads.

Forest prevented observation of Finnish soldiers from the roads or from the air. The Finnish soldiers were could move on skis and, in their snow gowns were nearly invisible, like ghosts. The tactic of the Soviets was to advance fast along the roads with the support of tanks. The rear and the sides of roads were not protected.

This gave opportunities for the skiing Finnish solders to attack against the convoys of the enemy. The Finns gradually developed a tactic of "motti," where a column was broken into parts and each part destroyed piece by piece. The forest cover facilitated guerrilla activities and breaking down the service roads.

Forest protected Finns also from gunfire. Often the forest reached up to the curb of the road and gave the chance to approach very near to the enemy. Under these conditions even small teams of Finnish soldiers equipped with the excellent Suomi-submachine guns could create large damages. Such attacks during night created shock and panic among the enemies.

The Finnish horse and its master were important support for soldiers in forests. Horses could move without roads, carrying tents, stoves, food, and ammunition as well as bringing back wounded and dead soldiers. The Finnish army transported dead soldiers to the graveyards of their home parishes. The Finnish artillery was then also mostly moved by horses. Horse transportation was complemented by pulks drawn by skiers and each soldier had also his backpack full of food, ammunition, and other personal necessities.

One benefit for orienteering by the Finns was that the soldiers fought on their own familiar terrain. Important for successful forest war during night, the team always had along a local fellow who knew the details of the terrain and how to proceed in the dark forest utilizing the special features of the topography. The Finns achieved glorious victory on 6 January 1940 over the Soviets along the road of Raate in Suomussalmi, northeastern Finland. With the "motti" tactics the Finns destroyed a whole Soviet division with minor casualties on their own side.

Forests also played key roles in the various support activities of the Finnish army. The steam engines used fuelwood to generate steam for train transportation. Some trucks operated with wood gas (carbon monoxide, CO), which was generated by burning wood in special furnaces while driving.

(continued)

Box 4.11 (continued)

Sulfite pulp was processed further to pure cellulose, which could be eaten by horses and cows. Also powder could be processed from pulp. In the sulfite process of pulping wood alcohol was produced as side product. It could be used in a bottle with a fuse – a "Molotov cocktail" – to destroy tanks.

During the Winter War no other war was active. Therefore, 200–300 foreign correspondents arrived to follow the spectacle, where at the end of 13 March 1940 the Finnish army was able to stop the Soviet army by retiring a little more than 100 km on the Karelian Isthmus and maintaining the other borders. Many books have been written in English about this heroic war (e.g., Edwards 2006).

If the forests had not supported the Finnish army so well, most likely the Soviet Union would have occupied Finland and the country would be linked to Soviet Union. The Finnish forests would become socialized. Corruption, forest degradation, and deforestation would return and the transition to sustainable industrial forestry would have been undermined. The Baltic countries after 50 years of Soviet Union occupation did much worse than Finland. For example, GDP per capita in Estonia is about a half of that in Finland (Mokyr 2006).

Forests have played vital roles in a number of other wars (Raumolin 1987). The Vietnam War ended 1975 and has been by far the largest war in the tropics where forests have played a vital role. Small North Vietnam never could have been able to drive the United States' Army out of the country without the help of the tropical forests. The US Army also recognized the tropical forest as an enemy by launching a large-scale chemical attack on it. A number of other tropical countries exist, where during the recent decennia forests have had multiple key roles in internal conflicts and wars (De Jong et al. 2007).

Throughout history, all the big powers, Great Britain, France, Russia, the United States, Japan, and Germany, have been seeking timber as one motivation of their colonization and foreign wars (Palo 2001).

In the 1950s more stable political times arrived. Finland joined the United Nations and the Union of the Nordic Countries (Denmark, Iceland, Norway, and Sweden) in 1950, which were stabilizing political factors. Finland also became integrated in the World Bank and later in 1961 to a special international trade agreement (EFTA). These steps strengthened her democratic political and economic bases.

The survival of the democratic political system was vital for the democratic forest legislation and its enforcement.

4.5.6 Conclusion

Enforcement of forestry legislation between 1900 and 1960 became gradually more effective. The Private Forest Act of 1917 had only a decade for enforcement with a scarce staff. The Private Forest Law of 1928 and the Forest Improvement Law of 1928 were until 1960 under most effective enforcement excluding the wartimes. The expansion of forest degeneration was slowed down in the farm forests. The enforcement of the institutions of the state forests also became more effective. Logging was expanded to the most remote state forests. Revenue generation in the state forests increased.

Next we shall introduce how forest-based development has supported forest transition from deforestation to sustainable industrial forestry.

4.6 Forest-Based Development

4.6.1 Introduction

The purpose of this section is to analyze the "role of forest industries in the attack on underdevelopment" (*Westoby* 1962) *in Finland. In other words, to apply the theory of forest-based development* (*bottom right of Fig. 2.4*) *to the history of Finland and to identify how the theory and practice supported the forest transition.*

The evolution of industrial exploitation of timber and the establishment of forest industries during preindustrial forestry were described earlier in Sects. 3.4 and 3.8. The theory of forest-based development was introduced in Sect. 2.6. We shall apply this theory here.

The share of exports in GNP has been 20–25% during the normal years of the period of 1895–1960 in Finland. This has been a rather typical level for small industrial countries. By specialization and expanding their exports small countries can speed up economic growth and livelihoods. Finland has followed an export-led economic development for more than a century (Vartia and Ylä-Anttila 2003).

According to the theory of forest-based development the forest industries have stronger than average linkages to other sectors, which will speed up differentiation and expansion of the national economy (Westoby 1962).

4.6.2 Forest Industry Ownership

Immigration was favored in Finland for entrepreneurs with know-how and capital. They came about a century ago, especially from Germany, Britain, Norway, and

Sweden, in order to establish sawmills and pulp and paper mills. There were also domestic commercial houses, which had been traditionally in the business of ship building, seafaring, and exports of tar, timber and sawnwood. Later, new domestic industrial entrepreneurs appeared, e.g., chemists and farmers (Kuisma 2006).

During and after World War I a number of foreign-owned companies were sold to Finnish ownership due to uncertain political conditions. Such companies included Norwegian Ab W. Gutzeit & Co., Ab Tornator, and Halla Ab, and British Ab T. & J Salvesen & Co., and Räfsö Ångsågs Ab. These five companies owned a total of 0.83 million ha of forest. Also some smaller companies, including some Russian ones, which were located close to the Russian border, passed into the Finnish hands.

Accordingly, after 1918 very few forest industry companies remained or became in foreign ownership. Some German, British, and French companies appeared later on but as a total the great majority of the capacity of the forest industries operating in Finland was under domestic ownership.

As a consequence, the profits remained in Finland and increasing profits were also mostly invested in improving the efficiency of the existing capacity or in expansion of the capacity in Finland. This contrasts recent practices in the tropical countries, where profits often are invested in speculation abroad. Naturally, this kind of domestic entrepreneurship in Finland was an important factor in support of economic growth and sustainable forestry.

The situation of Finland for a century ago resembles our contemporary membership in the European Union in the way of expanded duty-free markets with Russia since the middle of the nineteenth century. Finland was more industrialized than Russia and could export processed goods and import raw materials. If Finland had remained a part of Sweden, this would hardly have been possible because Sweden was more industrialized than Finland.

4.6.3 Towards a Forest Cluster

The Finnish corporations have traditionally been competitive in exports of forest products (Fig. 4.5). Accordingly, the forest sector has played a key role in export-led development, especially between 1920 and 1960, when the share of forest products exports from the value of the total commodity exports varied between 70% and 90%.

Most innovations in forest industries in the early days until 1900 were imported to Finland (Sect. 3.8). However, profit motivation also gradually created new domestic technology and machine production was also started, mostly with foreign licenses. Already towards the late nineteenth century the metal manufacturers (e.g., Tampereen konepaja, Karhulan konepaja, Varkauden konepaja) or some forest industry corporations started to manufacture machines for sawmilling and mechanical pulp and paperboard manufacturing (Kuisma 1993).

This development and production of machinery has grew and expanded to cover all production stages and fields in the forest sector. The first paper machine was

made in Finland in 1905. Finland had to pay big reparations to the Soviet Union after the World War II. This demand diversified the metal industries in a revolutionary way.

In 1948 the machine manufacturing companies established Metex, a cooperative, for joint foreign marketing of machines. The first paper machine was exported from Finland to Czechoslovakia under heavy competition in 1949. During the 1950s Finland had also started to produce more paper machines and also plywood machinery and chemical pulp machines.

State-owned machinery corporation Valmet Oy and four other firms were then constructing paper machines primarily for export (Jokinen 1988). In this way Finland arrived to an expanding forest cluster: forestry and forest industries induced machine and some other industries based on backward linkages to be established and expanded. R&D activities were expanded and consulting was mobilized, when Jaakko Pöyry Consultants became established.

Also forward linkages provided investment options. Publishing and graphics industries were expanded in further processing of paper. Furniture industries based their expansion on sawnwood and plywood. All kinds of traffic benefited from the expanding transportation services bought by the forest industries (Helander 1949). This was one aspect on the various linkage effects of the forest industries described here as a part of forest-based development (Sect. 2.6).

Consequently, during 1900–1960 a forest cluster was initially mobilized by utilizing the investment opportunities provided by the various linkage effects of the expanding forest industries. In fact, Finland has had a unique forest-based development in the whole world (Wardle et al. 2003; Mather 2004).

4.6.4 Impacts on the Finnish Economy

Haltia and Simula (1988) observed that during 1959–1980 the linkages of the forest industries with other sectors, such as metal, machinery, equipment, and energy/water industries, had grown. In fact, excluding consumer goods, the production coefficients of the total Hirschmanian linkage in the forest industries were highest among the ten integrated sectors of the economy in each study year of 1959, 1970, and 1980. Directly and indirectly via linkages the forest industries had generated one fifth of the total production growth during 1960–1979 in Finland.

Senghaas (1985) observed that the forest industries have supported favorable external terms of trade in support of economic growth in Finland. In fact, we know from other sources that the terms of trade have mostly been positive during 1860–1960. Forest industries have also used predominantly domestic inputs in its production: 95% of the total inputs. This has strongly supported the balance of payments.

The Finnish economy has grown second fastest after Japan between 1860 and 1990 (Fig. 4.12). Economic growth in Finland is unique among all the nations due to its heavy reliance on forest industries (Hjerppe 1989; Wardle et al. 2003; Mather 2004).

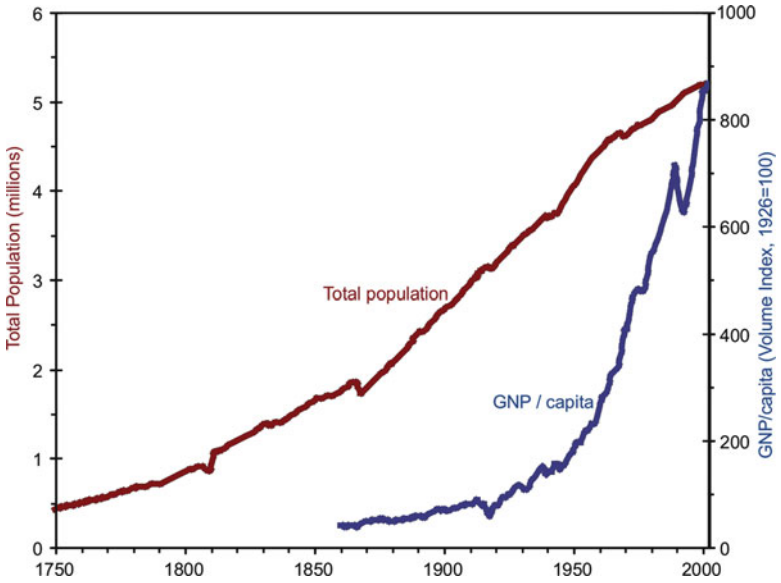

Fig. 4.12 Population since 1750 and GNP per capita since 1860 in Finland (Data source: Hjerppe 1989)

The worst depressions in the Finnish economy took place around our civil war in 1918, and later on in the early 1990s. The latter was more severe in absolute terms but the former one in relative terms. The Great Depression in the early 1930s and the Second World War in the early 1940s were overcome more easily in terms of the setbacks in economic growth in Finland.

This kind of strategic importance of the forest sector and the whole forest cluster to the national economy has brought some special favors to this sector by the government. The Finnish forest sector for a lengthy period benefited from the numerous devaluations of the Finnish currency markka.

The Union of Farmers (MTK) and the Central Association of Woodworking Industries (Suomen Puunjalostusteollisuuden Keskusliitto SPKL) were jointly so strong that they could lobby the government and the Bank of Finland to make devaluations for their mutual benefits (Ollonqvist 1998; Gylfason 2001). In this way frequent benefits from the currency markets were available.

4.6.5 Alleviation of Poverty by Forests

Expanding exports of forest products support economic growth both directly and indirectly via linkage effects and diversification impacts on the rest of the economy. Increasing stumpage and labor incomes of logging and timber floating followed expanding demands for roundwood. In this way poverty was gradually alleviated.

Also the value of forest holdings started to increase along with higher prices and increased demand for them. This allowed the forest owner a chance to use his forest holding as collateral for credit. Higher stumpage prices made forest investments gradually profitable and supported the motivation of the farm forest owners to intensify their forest management.

> Fifth and last, forest ownership in Finland is fairly evenly distributed among the Finnish population, and has been in that way for a long time. Forestry-related booms in the Finnish economy have not created a super-rich but small class of politically powerful rent seekers. Rather, the benefits that have emanated from the country's natural resources have been spread widely across the whole population without creating political or social tensions. (Gylfason 2001, p. 309).

Senghaas (1985) emphasized that equal income distribution has strongly supported income development and poverty eradication in Finland.

It is interesting that, so far, according to our observations, no Finnish scholars have observed this highly important role of private forestry! The linkage between the private forest ownership and favorable income distribution is a key finding.

Senghaas (1985) in his study on "The Finnish Development Path" found that incomes from exporting forest products led to a gradual rise in rural incomes, which along with agricultural modernization provided foundations for industrialization for broad-based import substitution. The diversification of industrial production towards metalworking and engineering industries started at the late 1930s and continued and strengthened immediately after World War II.

According to Westoby (1962) forest industries had higher than average forward and backward employment and income linkages into the other sectors. Therefore, giving priority for investments to forest industries would speed up economic growth more than investments to most other economic sectors with weaker linkage effects. This mechanism was actively realized in Finland between 1950 and 1960.

4.6.6 Conclusion

Today nearly one fifth of the Finns own forest either alone or as family members. This kind of income generator is missing in Russia, Canada, and most tropical countries, where the state is the sole or the principal forest owner. In fact, 80% of the world forests are in state ownership in one kind or another (FAO 2010).

Along with the growing demand for forest products under the prevailing clear and strong property rights and strict law and order in the society the stumpage and delivery prices of various roundwood assortments started increasing in real terms (Fig. 4.9). Also, the economy started to differentiate and urbanize leading to increasing incomes per capita and saturation of population growth (Fig. 4.8).

Forest-based development from 1900 to 1960 in Finland supported in various ways the transition to sustained yield forestry and industrial forestry.

Our theory with Finland's empirical experience in forest-based development of the boreal forests strongly supports the propositions by Leslie (Box 4.12) on the tropical forests!

Box 4.12 Forest Economist Alf Leslie's Thesis on Forest-Based Development in Tropical Forests

Alf Leslie was a praised forest economist of FAO from 1969 to 1981 (Douglas and Simula 2010). His view was that the conservation of the tropical forests relied on "two unavoidable facts of life."

First, a guaranteed and permanent livelihood has to be provided for the hundreds of millions of people who have no other choice but to clear forests for growing food.

Second, forest-based industrialization is one of the few means of doing this (Leslie 1995).

Unfortunately, these preconditions for ending tropical deforestation remain still on the waiting list, but they have been realized in Finland. Leslie's whole testimony for conserving tropical forests is given below.

> Three essential conditions must be met for forest-based industry to have a chance to work for development. The first is that the roundwood output is processed in the country of origin and the further along the production chain that the processing goes, the better. The second is that the workers employed are nationals of the country concerned and not imported immigrants. The third is that the forests are harvested and managed in such a way that adequate and appropriate replacement stands are put in place so as to sustain the raw material supply.
>
> In several well-documented cases where these conditions have been met, the thesis, set out so eloquently by Jack Westoby in 1962 – that forest-based industries can be powerful means for tackling the problems of economic and social underdevelopment – has been proved [*Ed. note*: see Forest industries in the attack on economic underdevelopment, *Unasylva*, 16(67): 168–201]. However, in most of the tropical forests, these conditions have been almost completely ignored, with even more well-documented results. This has resulted in condemnation of the thesis, rather than mispractice, even by Westoby himself. This is not just a mistaken, but risks being fatal to the cause of tropical forest conservation.
>
> There are two unavoidable facts of life that have to be faced in the whole issue of the conservation of the tropical forests, which has now subsumed the development issue. The first, despite all the hypocrisy with which the world tries to ignore it, is that conservation depends, above all, on providing a guaranteed and permanent alternative livelihood to the hundreds of millions of people who, in their present conditions, have no choice but to keep clearing forests to grow food. The second, despite all the propaganda to the contrary, is that forest-based industrialization is one of the few means for doing this on the scale and with the continuity needed. In effect, like it or not, sustained yield management and utilization of the tropical forests for industrial wood is a necessary condition for their conservation. This is not to say that forest-based industrialization can deal with all of the poverty that underlies deforestation; it can make a sizeable contribution but it is not the whole solution.
>
> The extension, under UNCED, of sustained yield into the broader and more stringent requirement of sustainable management adds another imperative to the three listed earlier. Timber harvesting for industrial purposes now has to be conducted in such a way that it inflicts no long-term, irreversible change of damage on forest ecosystems, their environments or the downstream social and ecological environments that depend on them. There is no escaping the fact that the extra cost of compliance

(continued)

Box 4.12 (continued)

will be substantial, perhaps more than can be borne by forest-based industries in the tropics as they now stand. So is there any hope at all?

I am sure that there is, but it will depend on a fundamental shift in industry practices. Innovative forms of market research, market development and standards of processing and servicing for specialized markets will need to be found and applied. The most drastic changes will be required in terms of thinking and attitudes, rather than in terms of technologies. To move ahead, such a reorientation will require the momentum that only a body such as FAO can provide. The thing to stress, without either apology or deference to popularity or vested interests, is the indispensable role of forest industries in tropical forest conservation. What is required is a capacity for imaginative lateral thinking, combined with the intellectual integrity and determination to counter a sadly misinformed and misguided public opinion.

Leslie (1995)

Alf Leslie, a native of New Zealand, was Director of the FAO Forestry Industries Division from 1977 to 1981.

Next we shall study the coevolution of forestry and society as a kind of continuation to the forest-based development at the bottom right of Fig. 2.4.

4.7 Coevolution of Forestry and Society

4.7.1 Introduction

The purpose of this section is to review coevolution between the forest sector and the society and its impact on forest transition in Finland until 1960.

Coevolution was defined in Sect. 2.3 as interactions between two systems with sufficient intensity and length of duration to influence the fitness of both. In Fig. 4.13 a causal model of coevolution between forest sector (forestry and forest industry) and society toward sustainability is introduced. We have already discussed the roles of ecological causes (Sect. 4.2) and socio-economic causes (Sects. 4.3 and 4.6). In Sect. 4.8 a review of the international causes/external world impacts on forest transition will be analyzed.

Next we turn to the remaining political and cultural factors and their coevolution between forest sector and society (Fig. 4.13). In fact, we already reviewed the political impacts by the society on forestry in Sects. 4.4 and 4.5. The further task is to clarify the political impacts of the forest sector on society along with the mutual cultural impacts. It is interesting to note that cultural sustainability has been lately included as a component in sustainable forest management along with economic, social, and environmental dimensions.

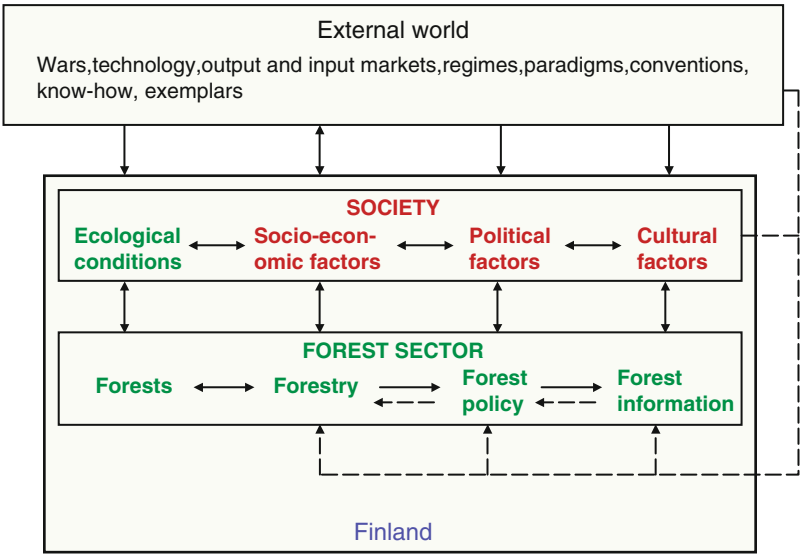

Fig. 4.13 Model of coevolution between forest sector and society towards sustainability with impacts from the external world. (Key: *solid line* = causal impact; *dashed line* = information flow)

4.7.2 Coevolution of Forestry and Politics

Coevolution of forestry and society has been a very specific Finnish outcome of the symbiotic evolution of forestry and society. Political impacts appeared in both directions. When forestry became important from the point of view of the national economy the governments wanted to regulate forestry by creating formal institutions, such as forest laws, and organizations for their enforcements, subsidies, and frequent devaluations of the Finnish currency markka. Forestry and forest industries could enjoy more of the special governmental favors by engaging its representatives as active high-level politicians.

Prominent foresters, forest scientists, and forest industrialists entered politics. Dr. A.K. Cajander, Professor of Silviculture, was Prime Minister for three periods during the 1920s and the 1930s. The Forestry Building (Metsätalo) in downtown Helsinki is a lasting monument to Cajander's political power (Photo 4.10). Mauno Pekkala, a forester, was a minister two times during those days and a Prime Minister after World War II. Dr. Osara, Professor of Forest Economics, was a wartime minister. Dr. Eino Saari, Professor of Forest Politics, was a minister in the early 1950s.

Antti Hackzell, the manager of Pitkäranta paper mill, became a Secretary of State from 1932 to 1936 and the Prime Minister during World War II. There were five other forest industrialists serving as ministers between 1920 and 1950. The forest industries also donated sizable sums of funds for the election campaigns of the conservative parties and individual candidates. All these nominations took place during the peak importance of forestry to the national economy.

Photo 4.10 Forestry Building (Metsätalo) just after its completion in 1939 in the downtown of Helsinki (Photo: Finnish Forest Research Institute/Erik Lönnroth)

The Central Association of Woodworking Industries was established in 1918. The Association donated large sums to a few conservative parties or individual candidates in each parliament election campaign during the interwar period. In response to this funding the Association expected political support in the government and in the parliament (Häggman 2006),

The government set tariffs for exports in 1919. They had to be fought out, which was finally mostly done in 1924. The Association was active in fighting against higher rail freight tariffs and increased taxes. A special tax department was established in 1920 within the Association to advise the members and to lobby the politicians (Poukka 1968).

The increasing political power of the leading foresters and forest industrialists was applied to establish new formal institutions in support of sustainable forestry and in fortifying the administrative independence of forestry from agriculture.

On the other hand, forest industries were able, due to their increased political power, to support the profitability of the companies, which again was a positive change from the point of view of sustainable forestry. Financially stronger companies were able to pay higher stumpage prices and wages for the workers.

Dr. Yrjö Ilvessalo was nominated as a professor of forest inventory at Metla in 1922. He completed and published the results of the first nationwide systematic sampling-based inventory of forest resources in 1924 (Ilvessalo 1924). Finland was first in the whole world to do this kind of inventory. Ilvessalo also directed the

second nationwide forest inventory in the late 1930s. Accordingly, he received worldwide fame (Box 4.13).

Ilvessalo became highly appreciated at home. Professor Yrjö Ilvessalo was nominated as a member of the Academy of Finland in 1948. The establishment of the Academy was a surprise for the public at large in the poor postwar Finland. Its mission was to promote sciences and arts. It was composed of 12 full-time salaried academicians, each of them considered as a leading figure in his field. The academicians were nominated by the President of the Republic.

Box 4.13 Finnish Professor Ilvessalo, US President Coolidge, and the US Forest Service in 1928

Photo 4.11 Professor Yrjö Ilvessalo, a member of the Finnish Academy of Arts and Sciences, in 1957; the parallel sampling lines of the 3rd national forest inventory in the background (Dr. Jaakko Ilvessalo's album)

Finland was the first country in the world where forest resources were surveyed nationwide with an objective scientific design with systematic sampling of the field plots. Professor Yrjö Ilvessalo led the survey and published the pilot findings (Ilvessalo 1924). This paper was published simultaneously in Finnish, Swedish, English, and French. Therefore, this unique achievement became well-known worldwide.

(continued)

Box 4.13 (continued)

We interviewed Yrjö Ilvessalo in 1982, when he was 90 years old and blind. However, his memory was still quite clear. He said that he traveled in 1927 to the Lake States of the United States of America for a fact-finding tour. His mission was to compile empirical data on the productivity of different forest sites in order to test the applicability of the forest type theory, which was created by a Finnish Professor A.K. Cajander (Ilvessalo 1929).

While Professor Ilvessalo was working in the Lake States, the US Forest Service invited him to consult the plans in progress by the Service for a large-scale forest survey. Accordingly, he traveled to Washington, D.C. While he was working there, his reputation reached the White House. President Calvin Coolidge expressed his wish to invite Professor Ilvessalo for a discussion.

Ilvessalo had been advised to dress himself formally in tails. He had, however, a serious problem to rent a formal dress due to a simultaneous carnival occasion. Finally, an owner of one renting firm loaned him the owner's own dress, when he heard the purpose of the visit.

President Coolidge formally welcomed Professor Ilvessalo. The visit lasted for 2 h. The first hour Ilvessalo responded to the question by the President, how were the Finns and Finland? Only 9 years earlier Finland had faced a civil war and a wave of starvation with US relief.

What about the second hour? The President asked, how is it possible to create valid and reliable data and information about nationwide forest resources based on sample plots with a scientific design and its implementation? Well, I explained it to him, said Yrjö Ilvessalo in our 1982 interview. Most likely the President was really interested in this theme, when he had invited Ilvessalo to the White House. They had discussed for a full hour the Finnish pioneering experience in statistically designed nationwide forest inventory.

A reporter from a Finnish-speaking daily paper "New Yorkin Uutiset" interviewed Professor Ilvessalo the next day in New York after his visit to the White House. On his return to Finland Ilvessalo read the interview while onboard the ship home, passing the Statue of Liberty. The paper reported the following.

When President Coolidge said goodbye to Professor Ilvessalo he had added: "It was so interesting to talk with you that, please, drop in again, whenever you happen to visit the US later on!" Ilvessalo told us that maybe the reporter exaggerated but certainly the President was very interested in the method and findings of the Finnish Forest Survey.

We learned in 2008 that this visit had a major impact on President Coolidge and the future of the US Forest Service. We happened to read a paper by J.D. Shaw (2008), where he reported that soon after the meeting of Coolidge and Ilvessalo, the US Congress launched the McSweeney-McNary Act, which facilitated forest research as a new task for the Forest Service

(continued)

Box 4.13 (continued)

with a continuous responsibility for a national Forest Survey in the United States of America.

D.D. Van Hooser et al. (1993) had earlier made the same reference in their paper on "The History of the Forest Survey Program in the United States," which we had not noticed earlier. The McSweeney-McNary Act directed the Secretary of Agriculture "to make and keep current a comprehensive survey of the present and prospective requirements for timber and other forest products in the United States, and of timber supplies, including a determination of the present and potential productivity of forest land therein, and such other facts as may be necessary in the determination of ways and means to balance the timber budget of the United States." This was the legal mandate for the national Forest Survey expressed only in one sentence.

The model of coevolution of Fig. 4.13 identified more impacts from abroad to Finland than vice versa. However, this history illustrates that, due to the international reputation of some Finnish forest scientists, at least one major policy change in the US took place due to an impact from Finland. An interesting question remains, how many other scientists have sat talking for 2 h with a sitting president?

4.7.3 Coevolution of Forest Industries and Architecture

Parallel coevolution impacts can be traced in urban planning and various fields of arts. Talented architects were invited by forest industrialists to draw town plans around their mills by wilderness rapids, where sizeable cities appeared. A "forest city" concept was created by Finnish architects during the 1950s. Whereas in England forest came to town (Nail 2008), in Finland town came to forest (Pallasmaa 1987).

The rapid expansion of sawmilling created two new towns: Kemi in 1869 on the estuary of the Kemi River on the northwestern coast and Kotka in 1878 on the estuary of the Kymi River on the southern coast, 150 km east of Helsinki. Both of the new towns were located favorably on the estuaries of long floating routes (Ahvenainen 1984).

There were three other older towns, which benefited most from the expansion of sawmilling. They were Viipuri, Pori, and Oulu. All of them were also located favorably concerning the water transportation of logs. The total population of these five towns was 34,000 in 1880 and and it more than doubled to 82,000 by 1913 (Ahvenainen 1984). It is understandable that under such conditions the owners and managers of the local sawmills had a strong say in local politics and town planning, in particular.

The forest industrialists also invited some of the foremost Finnish architects to design their pulp and paper mills, residencies, club houses, churches, schools, and hospitals, and also erected statues of loggers, log floaters, and hunters (Häggman 2006).

Sunila pulp factory with residential houses by Alvar Aalto, the worldwide known architect, is one of the nicest examples of the mill designs. Aalto also designed the headquarters of Enso-Gutzeit (today Stora Enso) in Helsinki. Furthermore, Aalto designed a residence, Villa Mairea, a masterpiece of Finnish architecture for the director of the A. Ahlström Corporation. This was the time when most forest industry corporations were family-owned. The business families competed for prestige in their allocations to the various arts (Pallasmaa 1987). The globalized firms have no more such ambitions in Finland.

4.7.4 Coevolution of Forestry and Visual Arts

The Kalevala, the national epos of Finland, has inspired a number of artists. Akseli Gallen-Kallela (1865–1931) was clearly the foremost one among them. He has been identified as the best illustrator of "The Kalevala" and also of "The Seven brothers." He painted many pictures with forest wilderness as a milieu, e.g., "A shepherd boy" (Paimenpoika Paanajärveltä) and "Hunting of lynx" (Ilveksen metsästys). Gallen-Kallela had one atelier at Tarvaspää on a beautiful island in Helsinki, but he also established another atelier "Kallela" in a wilderness at Ruovesi, 60 km north of Tampere. (Reitala 1987) Paper industrialist G.A. Serlachius financially sponsored Gallen-Kallela in various ways (Keskisarja 2010).

Eero Järnefelt traveled in 1892 from Helsinki to Lapinlahti, next to Iisalmi, 600 km north of Helsinki to paint a shifting cultivating family in action (Photo 3.1). We can see in this painting a wide-open forest site of shifting cultivation. A family is working hard to roll the burning tree trunks to an area where no fire existed (viertokaski in Finnish). We know by name each member of the family. In the foreground a 13-year-old girl is also working hard. In the painting at Ateneum National Art Gallery in Helsinki we can see how her eyes are tired. The painting very realistically describes that time of still rather common shifting cultivation (Sect. 3.2 above).

Forests, forestry, and forest industries were reflected also strongly in the visual arts, both in painting and sculpture, and in literature, poetry, music, and movies. Kalervo Kallio became an internationally known sculptor after World War II, having made the bust of Herbert Hoover, the past President of the United States, of General Franco, the dictator of Spain, Prince Rainier, ruler of Monaco, and Albert Schweitzer, a philanthropist and Nobel laureate of Peace in Lambaréné, Gabon, Western Africa. Next, Kallio sculptured a lumberjack peeling a log by the Kemijoki River in Rovaniemi by the Artic Circle (Box 4.14).

4.7.5 Coevolution of Forestry and Literature

Aleksis Kivi was the first author to publish major novels and plays in the Finnish language from the 1860s until the 1870s. His novel "The Seven Brothers" was published in 1870. The seven brothers in the story had lost their parents but they were

Box 4.14 Sculptor Kallio, President Hoover, Nobel Laureate Schweitzer, and a Lumberjack

Photo 4.12 A lumberjack statue by Kalervo Kallio along the River Kemijoki in Rovaniemi

I met Kalervo Kallio (1909–1969) at his atelier in Helsinki in 1963, when he had just returned from sculpting the bust of Albert Schweitzer in Lambaréné, which is located in today's Gabon, in Western Africa.

Albert Schweitzer managed a hospital there inside a park of tropical trees. He was a German Nobel Laureate of Peace. He had passed exceptionally his PhD in three fields: in theology, medicine, and humanities. Additionally, he was a master of organ playing, a music scholar, an author, and a philosopher. His ethics demanded that he demonstrate his principles in his personal life. Accordingly, Schweitzer wanted to honor life by personally serving the poor in his hospital. Albert Schweitzer was then, along with Albert Einstein and Bertrand Russell, one of the most well-known scholars worldwide.

After the bust was completed, Schweitzer gave Kallio a box of 50 wood samples of all tree species in the hospital park as a souvenir. Kalervo Kallio was still very impressed with meeting such a distinguished personality, visiting tropical forests and the hospital park. Especially, he wanted to demonstrate for us, a few visitors, how different and beautiful the tropical woods were.

Box 4.14 (continued)

Kalervo Kallio spent after World War II nearly two decades in the United States, where he sculpted the busts of President Herbert Hoover, President Franklin Delano Roosevelt, George Marshall, the postwar Secretary of State, Albert Einstein, a Nobel Laureate in Physics, and some other high-standing politicians and personalities.

Kallio was also invited to make the busts of Prince Rainier of Monaco and General Franco, the dictator of Spain. In Finland, Kallio produced hundreds of major monuments for graveyards and other public sites. He also produced 200 paintings and made some medals.

Kalervo Kallio grew up at his parents' farm at Nivala, Ostrobothnia. The original aim was that he would continue family farming. Therefore, in the early 1930s he passed a degree in an agricultural college. But he could not resist the pull of the arts and some years later he entered an arts college in Helsinki. He was the son of President Kyösti Kallio.

Accordingly, Kalervo Kallio, due to his background at the farm, must have been keen on forestry from his youth. Otherwise, he may not have accepted in 1955 an offer to make the statue of a lumberjack, who was peeling a prop in a curved position (Photo 4.12).

Kallio wanted to describe him as a hero of work. The statue is located at the edge of the River Kemijoki, which was the most important river for timber floating until 1991. Kemijoki Oy, a hydroelectricity company, financed this undertaking. The statue was meant to symbolize the importance of logging for northern Finland.

Other similar statues representing log floaters have been located along the River Pielisjoki in Joensuu and along the River Kymijoki in Heinola. A total of eight such log floater public statues exist in various parts of Finland (Hast and Lanko 2009).

already mostly grown-up youngsters. They had a disagreement with a parish clerk, who tried to teach them to read. Other conflicts with their neighbors also appeared. Accordingly, the brothers decided to rent out their main farm and move into a wilderness with hunting and gathering as well as with shifting cultivation. The novel describes realistically with humor the hard life in the wilderness (Kivi 1991).

Later on, Johannes Linnankoski, Joel Lehtonen, Ilmari Kianto, and Pentti Haanpää before World War II and others afterwards were also inspired by forests and forestry in their novels and short stories. Loggers, timber floaters, and workers of forest industries were often described by Finnish authors, such as Hella Wuolijoki, in her plays in the 1930s. She was a manager of a sawmill company. Toivo Pekkanen wrote a novel, "In the Shadow of a Mill," which described life in Kotka after the civil war in 1918 (Suhonen 1987).

Why is the Finnish literary tradition different from other countries? Perhaps nowhere else has such a sizeable share of literature been devoted to the motives of the forest sector. The Finns have lived, and still live, in the forests, even the towns are often in the forests. The welfare of the Finns was traditionally forest-based and recreation in forests has always been popular. For example, today Finland has more hunters than any other member country of the European Union. Finland's population is only 5 million.

4.7.6 Coevolution of Forestry, Music, and Movies

The analyses concerning music compositions and forest have been classified into three categories: symbolic use, music, and text. Jean Sibelius, a worldwide famous Finnish composer, created his master piano pieces with such names as "Mountain ash," "Pine," "Spruce," "Birch," and "Aspen." His melody poem "Tapiola" imitated the magical forest of the ancient Finns. The "Fairy Tale" ("Satu") had its inspiration in the traditional forest tales (Hako 1987).

Also in popular music we find hundreds of forestry, timber floating, and forest-inspired pieces. Often they have been composed for movies of such milieus. A major collection of traditional songs of loggers and timber floaters was compiled in the 1990s. The aim was to identify both forest-related songs and melodies used in meetings and festivities of loggers, floaters, and other forestry staff. A total of nearly 1,000 songs were recorded (Koivisto et al. 2003).

The National Forest Museum Lusto has about 500 forest-based Finnish films in its archives. They are both documentaries and narratives. Finnish film companies produced 27 long narrative films with themes of timber floating and logging during 1923–1950. This richness of forest-related films is a specific character of Finnish film production. Hardly any other country has so high share (7%) of the total film production dedicated to forest themes.

4.7.7 Conclusion

Forest-based arts had wide-scale impacts on people, especially during the nineteenth century, when the Finnish national identity was created largely with the help of the various artists. This activity continued strongly during the first half of the twentieth century, when the national sovereignty was created. These were times when the forest sector created largely the economic bases for the young nation and forest-based arts the cultural bases through schools and media. Such arts created favorable attitudes among the citizens and the governments in promoting sustainable forestry in Finland.

Next we shall review the inter-sector impacts (on the right of Fig. 2.4) on forest transition.

4.8 Inter-Sector Factors

4.8.1 Introduction

The purpose of this section is to review the underlying inter-sector causes in support of forest transition to sustainable industrial forestry in Finland between 1900 and 1960. We shall proceed in the order of the inter-sector underlying factors according to our theory (*on the right of Fig. 2.4*).

Finland was a poor peripheral country during the nineteenth century comparable in many respects with poor tropical countries today. However, the surrounding world then was quite different from today.

The number of landless rural people was growing fast in Finland. Landlessness and poverty were strongly linked during the agrarian society of those days. The share of industrialization and urbanization was still quite low. The productivity in agriculture had stagnated close to the end of the nineteenth century. Fuelwood had traditionally been the dominant energy source in a similar way as in the tropics of today.

4.8.2 Population

The systematic collection of population data in Finland and Sweden dates back to 1750 (Faggot 1746). This is the longest official national time series of human population in the world. Population growth was rapid, especially during the late eighteenth and the nineteenth centuries (Fig. 4.12). It was accompanied by fast economic growth during the latter half of the nineteenth century, or from the time we have national income data (Hjerppe 1989). We have good reasons to assume that economic growth was much slower during the earlier periods.

During the nineteenth century the population grew 2.5 times and in the twentieth century it doubled. A transition in population growth started to be visible during the second half of the nineteenth century, but actualized much later. It was not before the second half of the twentieth century that population pressure supporting forest degradation and deforestation started clearly to release along with alleviation of poverty and urbanization.

The population increased in Finland from one to two and a half million between 1800 and 1900. More people demanded more wood for fuel and construction and more cattle, which increased grazing in forests. There was also pressure to continue shifting cultivation. All these changes increased scarcity of forests nearby to densely inhabited areas.

The Senate became worried about the forest situation and ordered the first national assessment of forests to be carried out in 1850 (Map 3.3). The perceived widespread scarcity of forests mobilized new forestry reforms (Sect. 3.6).

Population growth was facilitated not only by gradual reforms in food production but also by new technology of steam engines, pulp and papermaking out of wood, and other industrialization as well as by the 109 years of peace in Finland as a politically autonomous part of the Russian Empire, expanding "home markets" in Russia and expanding exports also outside Russia. Forest industries expanded gradually to produce leading export commodities (Fig. 4.5). Finland entered into an era of steady and comparatively fast economic growth (Fig. 4.12).

The impact of population pressure on forest degradation and deforestation depends on the level of technology (Palo 1994). In the latter half of the nineteenth century iron replaced wood in ship construction. Demand for wood and tar for ship construction gradually disappeared. On the other hand, new technologies in forest industries started to create more demand for sawlogs and pulpwood. These transitions were spatially diversified.

As a conclusion, population increase was gradually declining along with expanding human capital until 1960. Simultaneously expanding imports and domestic production were increasing new technology in the forest sector until 1960. Urbanization from 1900 to 1960 was also rapid. All these trends decreased the population pressure on forests.

4.8.3 Poverty: Income per Capita, Health and Education

The skewed tenure situation accompanied by poverty was a driving force in shifting cultivation and tar distillation expanding forest degradation and deforestation. The Grand Land Reform and the establishment of the Forest Service made the toll of the poor even worse towards the end of the nineteenth century, because open access to village forests and state forests was closed down (Ruuttula-Vasari 2004; Tasanen 2004).

Poverty is viewed here wider than income per capita. There exist many poverty concepts and indicators (Palo 2004). We adopt here the Human Development Index (UNDP 2006) as a most relevant concept and indicator at the national level. Unfortunately, UNDP started to compute these indexes only in 1970. But the underlying concept is also relevant in history. UNDP has defined human development to be composed of income per capita, health, and education.

Poverty was decreased to a great extent by various mechanisms. Industrialization was expanded and at the same time a mass emigration to North America took place, especially from the western coastal area of Pohjanmaa. In that area the previous exploitation of forests by wooden shipbuilding and tar distillation had exhausted the forest resources (Map 3.3).

While the central and eastern areas had ample remaining forests, forest-based industrialization could be mobilized there and in the southeastern coast, where timber could be floated from those forest-rich provinces. This brought increasing stumpage incomes to farmers and tenant forest owners (Laine 2004) and labor incomes to landless people as forestry workers (Helander 1949). What about human health, another component of HDI besides income per capita?

The mortality of children below 1 year decreased in Finland from 15% in 1900 to 0.4% in 2000. This, along with Sweden, Norway and Japan, represents the lowest figure in the world. The dramatic decline is due to a decrease in epidemics, and improved hygiene, nutrition, and extension. Unfortunately, many African countries still have infant mortality higher than 10%, the level Finland had over a century ago (Nieminen 1999; UNDP 2006).

The life expectancy at birth has grown in Finland from 45 years in 1900 to 73 years in 2000 for men and from 47 to 81 years, respectively, for women. There has been a continuous increase in this life expectancy, which may be considered the best overall indicator of human health (Nieminen 1999). Still today ten African tropical countries have life expectancy below the level that Finland had in 1900 (UNDP 2006). There remains the third component of HDI: education or human capital.

The quality and quantity of human capital has become revolutionized in a century. The Lutheran church began giving courses in literacy to the Finns in the seventeenth century. A plan to launch a universal elementary school in Finland was adopted in 1866. A number of elementary schools and also the first high schools were established toward the end of the nineteenth century.

It was ordered in 1898 that each municipality had to establish elementary schools in a way that no children had to travel more than 5 km to school. A law on compulsory education was finally launched in 1921 (Lampinen 1999).

With the combined efforts of the church and the national and local governments, 70% of the adult population was able to read by 1800 and 100% by 1900. It took a longer time to also learn to write. It was assessed that about half of the Finns could write by 1910 and all the adult people by 1930.

One percent by 1910, 8% by 1960, and 50% in 1997 of 18-year-olds earned a high school diploma. A university was established in 1640 in Turku. University education increased rather slowly even during the first decades of the twentieth century. One percent of the relevant age group was registered at the three existing universities in 1925, 2% in 1938, and 12% in 1955 (Lampinen 1999).

The first vocational training and public high schools (kansanopistot/työväenopistot) were established towards the end of the nineteenth century. Their number and role increased rapidly in the twentieth century. Vocational training of forestry workers and farmer forest owners appeared relatively late, in the 1950s. On the other hand, when everybody was able to read already by 1900, there was a fruitful response for forestry extension work.

We may conclude the following about the impact of the alleviation of poverty on forestry. Improving health and education were increasing the options for earning an income, and vice versa. Jointly, prolonged life, improved education, and increased incomes were decreasing poverty and advancing human development as measured by the Human Development Index of the United Nations Development Program (UNDP 2006). Decreasing poverty was supporting in various ways Finland's transition to sustained yield forestry.

A century ago Finland was already advanced in education in comparison with the contemporary tropical countries. Illiteracy is still a wide problem in the tropics,

where education, especially that for girls and women, is lacking and partly hampering the adoption of sustainable forestry (UNDP 2006).

4.8.4 Agricultural Productivity

During the twentieth century forest clearing was expanded by shifting cultivation (Map 3.1) and for permanent arable fields (Sects. 3.2 and 3.3). This took place along with the population and income growth (Fig. 4.12). In the last half of the eighteenth century the average annual population growth was 1.3% and in 1815–1865 still 1.0% (Ojala and Nummela 2006).

However, there hardly existed any respective productivity increase in agriculture until about 1900. Shifting cultivation was a land-extensive form of subsistence, while more dense population required more land-intensive forms of agriculture (Åström 1978).

Finland lies just north of the 60th northern latitude. It is the most northern country in the world but has maintained a large agricultural production (Map 1.1). In the late 1860s Finland experienced a large-scale famine, losing one tenth of her inhabitants to starvation and sicknesses due to poor nutrition. A few additional famines appeared as late as the early twentieth century. Forests provided some emergency nutrition in these cases (Box 3.10). Today agricultural production in Finland mostly exceeds domestic consumption (Ojala and Nummela 2006).

This has been achieved partly by increasing the area of arable fields and partly by increasing the number of domestic animals. The area of arable fields was expanded continuously until 1970, mostly by clearing forest but also partly by draining and burning peatlands and by transforming meadows into fields. The large colonization programs (Sect. 4.4) were partly causing this expansion by converting forests into permanents fields. Under the Finnish ecological and socio-economic conditions no wastelands were created after this conversion, parallel to today's tropics.

A field is the most important production factor in agriculture. The total area of arable fields was 1.6 million ha in 1900 and two million ha in 1920. The area of fields comprised 2.7 million ha in 1969. It was 300,000 ha larger than in 1950. Mainly under the various colonization programs new fields had been created to equal the same amount that Finland had lost to the Soviet Union at the end of the war in 1944. The amount of fields was 2.4 million ha in 2000, of which 0.4 million ha were laid aside from active use as fallows (Ikäheimo 1999).

The number of horses increased to about 0.4 million until the 1950s. With an increasing number of tractors, the number of horses declined and their use in logging ended during the 1960s. When the number of horses rapidly declined, it released fields from hay to other production.

Farm tractors were replacing horses in extraction of logs already to some extent in the late 1950s but nearly totally in the 1960s. Gradually special logging machinery replaced the farm tractors toward the end of the 1960s and early 1970s (Fig. 4.14). This replacement broke the traditional linkage between farm-

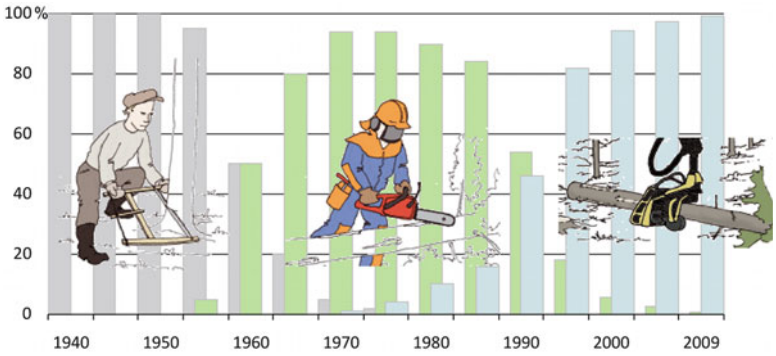

Fig. 4.14 A transition in logging methods in Finland, 1940–2009: traditional manual saw and axe, power saw, logging machine (*Source*: Metsäteho 2010)

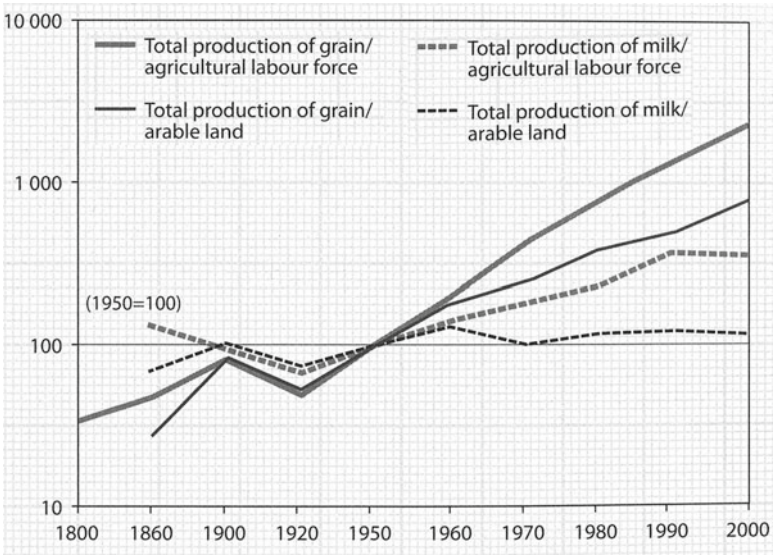

Fig. 4.15 Productivity indices of Finnish agriculture, 1800–2000 (Ojala and Nummela 2006, p. 83)

ing and forestry, when simultaneously training and recruitment of permanent forestry workers also replaced the seasonal loggers. This change caused a vast emigration from Finland to Sweden in the late 1960s and in the early 1970s (Vaara 2010).

The total production of crops and milk increased about threefold between 1900 and 1960. Increases in productivity along with expansion of arable fields and number of cows have played key roles (Fig. 4.15). It is interesting that the highest rate in the growth of productivity coincides with the highest share (70–90%) of forest products in the commodity exports from 1920 to 1960.

The same period also witnessed the strongest linkages between agriculture and forestry. In the 1930s about equal net forestry and agricultural incomes were produced for the farmers (Laine 2006). A major part of the forestry income must have been invested in raising productivity in farming.

Intensification of agriculture saved forests to some extent from the conversion into fields. Also towards the end of the 1960s afforestation and fallowing of marginal fields with subsidies was initiated in order to prevent domestic agricultural production from exceeding domestic consumption. These activities also supported sustainable forestry in Finland.

In the tropical countries intensification of agriculture has been highly cumbersome for various reasons. Weak and unclear property rights have established one fundamental hindrance. A corollary to this has been the undervaluation of forests. The increase of food production in the tropics has taken place primarily via extensification of agriculture. This has meant continuous tropical deforestation (Sect. 5.1).

4.8.5 Transition of Fuelwood Consumption

The consumption of fuelwood increased in the nineteenth century along with increases in population, manufacturing, electricity generation, (mostly hydropower but also partly fuelwood) and railway traffic. The state railways VR from its birth in the 1860s until 1960 had problems in purchasing fuelwood at competitive prices. Fuelwood was used in generating steam power by the engines.

Accordingly, VR started to import coal in 1890. Twenty years later the share of coal from the total use of fuels was one third. The wars blocked coal imports. In 1930 the share of coal had grown to 60%. There existed a blockade of imports of fossil fuels during and after World War II. But in the 1950s the use of coal and also oil gradually replaced wood as a fuel (Helander 1949; Sevola 1999).

Fuelwood was primarily used for residential heating both in rural and urban housing and secondarily also in industrial heating. The non-industrial use of wood was predominantly composed of fuelwood. There were clear peaks in fuelwood consumption during the wars (Fig. 4.4).

In fact, extensive forests were in many ways supporting the successful defense by the Finnish army against the Soviet Union. As an example, fuelling the engines by wood maintained railway traffic during the crises. The interwar period was quite balanced. The peak in fuelwood consumption happened just after World War II, when the imports of fossil fuels had not yet commenced (Sevola 1999).

The total consumption of roundwood in Finland as an annual average was about 30 million m^3 during the two first decades of the twentieth century. Fuelwood for heating of houses, mills, and railway engines comprised about two thirds of the total non-industrial wood consumption. It was comprised predominantly of fuelwood but also roundwood for exports, for sleepers, poles, pilings, farm construction, and fences (Sevola 1999).

The total consumption of domestic roundwood was estimated as 47.1 million m^3 in 1927 by data based on industrial statistics and on a representative sample survey of real estates in the whole country (Saari 1934). The total increment was estimated by the first national forest inventory at little less than 47 million m^3. When this year was the top of the business cycle, it could, for first time in history, be safely deduced that sustainable use of forests had been maintained (Fig. 4.3) (Sevola 1999).

Industrial processing used 49% of the above total consumption of roundwood and the non-industrial use, housing, exports, traffic, and communication, 51%. Housing consumed 37 million m^3, of which fuelwood comprised 23 million m^3 or 77% (Saari 1934). Similar national surveys of wood consumption were executed in 1938, 1955, and 1965. They were scheduled to match the respective national forest inventories in order to be able to compare the annual increment with the annual timber drain (felling + natural drain by storms, fires and decay) (Box 4.1; Sevola 1988).

Since the early 1950s industrial use of roundwood permanently exceeded non-industrial use. This change was primarily due to increased consumption by forest industries. In the 1960s fuelwood consumption decreased strongly and unexpectedly under liberalizing of imports of fossil fuels and a major new capacity for electricity generation by hydropower. The exports of roundwood also decreased dramatically during the same period.

The annual timber drain exceeded the annual increment around 1960 (Fig. 4.3). This created alarm among foresters and politicians alike. A series of national forest programs were generated to sustain forest resources for the expanding forest industries and economic growth. The declines in consumption of fuelwood and exports of roundwood had not been anticipated. They played a major role in sustaining forests along with increasing the stem volume increment by the programmed intensification of forest management.

In 2004 global fuelwood consumption was 1.8 billion m^3 and the respective consumption of industrial roundwood 1.6 billion m^3. In Africa the respective figures were 546 million m^3 and only 67 million m^3 (FAO 2007). Wood fuel plays a key role in the supply of energy and in logging, forest degradation, deforestation, and desertification in the contemporary tropics, and especially in Africa.

4.8.6 Conclusion

We have reviewed here the impacts of the inter-sector factors on the forest transition in Finland from 1900 to 1960. There was a saturation in population growth during this era. Both human capital and life expectancy as well as income per capita increased. It refers to alleviation of poverty based on our wide poverty concept. Productivity in agriculture has continuously increased, while fuelwood was largely replaced by fossil fuels in the 1950s. All the inter-sector factors have supported Finland's transition to sustainable industrial forestry.

In Finland the decrease of fuelwood consumption below the industrial uses since the 1950s was one more factor supporting the transition to sustainable forestry, but it was also an additional indicator of transition of Finland from preindustrial to industrial forestry.

Next relevant international factors in support of the transition to SYF will be introduced.

4.9 International Factors

4.9.1 Introduction

The purpose of this section is to review the impacts of the underlying international causes on forest transition in Finland between 1900 and 1960. (*At the top of our theoretical model of Fig. 2.4.*)

Around 1900 Russia started to suppress the home rule of Finland. General Governor Bobrikov, who implemented this policy was murdered in 1904, which made the situation worse. Russia lost a war against Japan in 1906. This in many ways brought about the hay days of national awakening and political reforms in Finland.

New political parties, cooperative movements, and financial and cultural associations were created, including one to promote private forestry within the Finnish-speaking territory (Tapio) and another in the Swedish-speaking coastal territories (Skogskultur). The education of foresters was transferred from Evo to the University in Helsinki in 1908. The Society of Forest Sciences (Suomen Metsätieteellinen Seura) was established in 1909. Increasing international impacts also appeared.

4.9.2 Impacts by International Politics

FAO and the government of Finland organized the World Forestry Congress III in Helsinki in 1949 (FAO 1949–1950). The conference was the first one organized by FAO on worldwide basis. This was also a great global support to the democratic government of Finland, which then was in a rapid recovery phase from the calamities of World War II.

Dr. Eino Saari, Professor of Forest Policy at the University of Helsinki, was the chairperson of the national organizing committee of the Congress. He also was able to add to the final declaration of the Congress an expansion to the paradigm of the sustained yield forestry as follows. Instead of maintaining the yield non-decreasing over time, it should be continuously increased (Saari 1949). It was called the principle of progressive forestry. This was in accordance with the new theory of economic growth in general economics.

We may assume that this novel principle of progressive forestry, when endorsed by FAO, had an impact on the forthcoming Finnish forest policy. Especially since the 1960s the principle was followed in the intensive national forestry planning activities.

The FAO recommendation on multiple use forestry came to Finland by Saari (1952) without any immediate impacts on practical forestry. FAO mobilized its timber trend studies by the late 1950s. They were largely used in Finland for feasibility studies to expand forest industries.

During 1900–1960 no foreign consultants in forestry were invited to Finland, in contrast to the middle of the nineteenth century. Otherwise, global and international forest and environmental politics were not yet born. No legally or non-legally binding intergovernmental laws or agreements concerning forestry in Finland appeared.

We may interpret international wars as the extension of foreign politics. Therefore, a review of the impacts of international wars is given next.

4.9.3 Impacts by Wars

When Russia lost its war against Japan in 1906, it was a great surprise not only to Russia but also to the rest of the world. This was the first step by Japan in its series of imperialistic wars in hunting for timber and oil. In the treaty Japan got the southern part of Sakhalin Island and open access to take over Korea. Both of these territories became important timber suppliers for Japan until the end of the Japanese occupation in 1945 (Palo 2001).

Huge demonstrations happened both in Russia and in Finland as the consequence of the lost Japan war. The Emperor Nicholas II initiated reforms in Russia proper and also in Finland in order to improve the welfare and the social atmosphere. Russia got its own parliament "duma," where Finland was not represented.

Finland was able to create a most modern one-chamber parliament of its own in 1906, still under the Russian Empire. Suffrage was extended to all adult men and women. This radical democratic reform was the first one of its kind in Europe and the second one in the whole world, only after New Zealand. Women in Finland were first in the world to be eligible as members of parliament. The new parliament facilitated the agrarian party (Maalaisliitto) and the labor party (Suomen Sosialidemokraattinen Puolue) to become the largest parties and strong political players.

This played its role in the forthcoming forest policy reforms. For some years already there had been a social tension in Finland among farmers due to the increased acquisitions of forest holdings by forest industry firms. The reformed parliament made a law in 1915 to reject purchases of forest holdings by forest industry firms. Its enforcement was not, however, effective. After an additional law of 1924 (Lex Pulkkinen) non-industrial private forest ownership became stable and expanding also partly due to some other laws to promote colonization (Sect. 4.4).

Russia lost World War I to Germany in 1917. This ended the rule of Nicholas II in the March Revolution of 1917. The loss in the war was also one cause underlying

the communist revolution in Russia in November 1917. Another cause was the emergence of the socialistic political ideology from Germany and Britain to Russia.

Finland took this opportunity and declared the country sovereign on 6 December 1917. After 109 years of home rule the democratic institutions were already highly diversified and advanced in Finland. Only a national army, diplomatic missions, and a substitute for the Emperor as the supreme political power had to be created (Jussila 1987).

The communist revolution ended all imports by Russia from Finland. Russia had been a favorable duty-free zone for Finnish exports of many kinds, including pulp and paper. The Finnish forest industries had to establish a new strategy for penetrating the western markets in the sales of pulp, paper, and paperboard. Sawnwood had been traditionally exported to Western Europe.

An operational solution in the form of exports marketing cartels, Finncell, Finnpaper, and Finnboard, was found based on a German model of import cartels. In 1918 Germany was the principal buyer of pulp and paper products from Finland (Poukka 1968).

After 1918 the forest products dominated the Finnish exports until the 1950s, with a 70–90% share of the total (Fig. 4.5), because the textile, machine and agricultural industries, which had been major exporters to Russia, could not penetrate to the western markets.

A civil war took place in Finland in January–May 1918. This was caused by various social inequalities in Finland, the ideology of socialism, and by imitating the neighboring communist revolution in Russia. The war lasted less than a half a year but the time of political instability continued somewhat longer.

The war had an international linkage not only in the Russian Revolution, but also when a German army unit arrived by invitation to support the "white army." After the bloody war a number of social reforms were implemented, such as liberation of tenant farmers, colonization measures of the landless people, and prevention of forest industries from buying forest holdings (Sect. 4.4).

The new government also sacked the Director-General of the Forest Service, P.W. Hannikainen, and nominated Dr. A.K. Cajander, Professor of Silviculture, as his follower. Hannikainen had not stopped his daily work in his office as the rest of the staff had during the "red government" in Helsinki.

The "white government" by surprise socialized in the fall of 1918 two forest industry companies, Ab H. Gutzeit & Co and Ab Tornator, which had been in Norwegian ownership. The socialization was based on pressure by Germany, which was afraid that these strategic resources would easily be transferred into British ownership (Kuisma 1993).

Germany was still at war with Britain on the western front. Germany had made a pact in April 1918 with the "white government" of Finland in order to launch a military intervention to southern Finland in support of the "white army." The pact included control of Finnish foreign trade and open access to the Finnish forest and other natural resources by German citizens and firms. The socialization of the Norwegian firms was not mentioned in the pact but was in line with its contents (Rautkallio 1977).

The new democracy in Finland was also at stake in the early 1930s, coinciding with political upheavals in Italy, Germany, and some other European countries. However, democracy survived in Finland. Typical of the politics of the twentieth century, political power rested for the longest times with the agrarian party and/or the social democratic party, both of which strongly supported the democratic system of government and also the poorest strata of the population.

World War II, 1939–1945, caused a severe loss of forest resources and industries to Finland. Twelve percent of the forest area (Fig. 4.2) and a capacity of 0.5 million tons of pulp and paper mills, 50,000 m^3 of plywood as well as a capacity of 0.6 million m^3 of sawnwood had to be given to the Soviet Union according to the treaties of 1944 and 1947 (Lindroos 1993).

While exports were greatly decreased by the wars (Fig. 4.5), the industrial use of roundwood decreased from 30 million m^3 in 1937 to 10 million m^3 from 1940 to 1944 (Fig. 4.4). The use of fuelwood increased during wartime, but not as much as the previous decrease. Accordingly, the stem volume increment clearly exceeded the respective timber drain (Fig. 4.3) and the growing stock of trees increased in the remaining Finnish territory.

The war also raised Dr. N.A. Osara, Professor of Forest Economics, as a Minister of Forestry and Energy Supplies in the wartime government in 1943–1944. He was able to enact a law on reforestation of marginally productive forests in 1943. Dr. Osara continued to be an influential forest politician in the postwar era. As a later Director of Tapio he expanded forest management planning and initiated logging road construction in the private forests. As a Director-General of the Forest Service (Metsähallitus) from 1952 to 1960 he mobilized the expansion of large-scale clear-fellings in northern Finland. These new activities created additional employment and incomes.

In the 1940s Finland experienced an energy crisis among with all the other calamities and problems created by the wars. A comprehensive state regulation of forestry was created. During the war some oil and coal were imported from Germany but for some years after the war those foreign energy supplies were closed for Finland.

Dr. Osara led a national body to organize supplies of fuelwood and charcoal, which were most essential for the survival of the country. Even railways and road traffic were dependent on wood-based fuels. All this activity created extra employment and incomes during the period. This was highly valuable for the society, especially during the postwar years (Lindroos 1993).

Minister Osara established a committee in 1943 for complementing the ban of deforestation with obligatory minimum requirements for silviculture to prevent forest degradation and to replace the private forestry act of 1928. The forestry law of 1948 in Sweden was used as an exemplar. The committee completed its mission in 1953. This proposal was strongly supported by professional foresters but was opposed by the agrarian party and the Farmers' Union MTK. The law proposal was never accepted. Afterwards, the foresters began to innovate new ways to intensify forestry management via national forestry programs (Palo 1993).

In the aftermath of World War II Europe experienced a remarkable boom in reconstruction of housing and rehabilitating the industries destroyed by the war.

This created a boom in demand for forest products in 1947–1949 (Ollonqvist 1998). This boom was welcomed by the Finnish national economy in order to create additional employment and income for the people and country ruined by the 5 years of wars.

The Korean War in 1950–1953 caused an even greater boom in the demand for forest products in Europe. This war was located far away from Finland, but its outbreak raised speculations of a potential World War III. Therefore, the demand for forest products was strong. This benefited the Finnish forest industry firms and forest owners. Never before in history or afterwards have the stumpage prices risen so fast. This created more employment and incomes for a high number of people. In fact, labor input in forestry was highest during this boom period (Fig. 4.7).

In 1952 Finland exported to the Soviet Union the last goods as reparations of the war damages required by the Treaty of Paris in 1947. This postwar epoch under compulsory reparations to the Soviet Union had been important in developing Finland's metal and machine industries, especially pulp and paper machine production and ship construction (Jokinen 1988).

Also in 1952 the rationing of consumption by the government was ended. Finland started to open more doors to open trade with western Europe. Finland never received any financial aid from the US Marshall Plan, as most other European war-going nations did. Therefore, the rapid postwar recovery has special comparative merits for Finland.

As a summary the wars had impacts both on the transition to sustainable forestry and on the impacts of forestry on society. First, postwar reconstructions increased the demand for forest products and the value of forests. Second, the major privatization of forests after both 1918 and 1945 (the beginning of Sect. 4.4) created numerous small holdings all over Finland. This expanded the supply of labor for logging and floating and maintained wages at low levels until the 1950s. This again supported increasing stumpage prices and the value of forests.

Third, the privatization of forests with increased number of holdings increased equal distribution of forestry incomes both functionally and spatially, which again strengthened economic development. A real coevolution of forestry and society took place due as a consequence of the wars. One specific impact of forests on society has been the protection function of forests during the wars (Box 4.11).

4.9.4 Foreign Technology in Logging

It is surprising how slowly technological innovations were created in forestry from the last decades of the nineteenth century until the 1950s. Trees had been felled by axes until the end of the nineteenth century, but since then a two-man manual saw with a broad blade (Photo 4.5) from North America and Sweden gradually penetrated to the logging of large-diameter timber (Lehonkoski 2004). This saw was also used for bucking large-dimension trunks into relevant assortments.

Later on, a one-man manual saw with a narrow blade with wooden frames was developed in Finland for small-dimension trees (Photo 4.6). In the 1950s the wooden frame was replaced by a steel frame (Photo 4.7) originating from Sweden. Both sawlogs and pulpwood were manually debarked in the forests with simple manual tools (Photo 4.8) (Rauhalahti 2006).

As forestry undergraduates we were among the pioneers in using power saws in our university logging practice in January 1960. I felled trees with a "Hyry" power saw weighing 14 kg, which was tiring even to carry along. It was a Finnish model, which never successfully penetrated the markets. We still applied the hand tools seen in Photos 4.5–4.8 in debarking, but simultaneously pioneering machines for debarking arrived along the logging roads in Finland.

It took a long while before truck transportation of roundwood on roads and highways started to grow in importance. In fact, after various experiments in earlier decades, truck transportation did not start to expand in Finland until the 1950s. This was also the beginning of trials with farm tractors and their gradual expansion in replacing horses in extraction of logs to the roadside or riverside. The first power saws arrived simultaneously. A large-scale breakthrough of tractors and power saws took place after the 1950s (Fig. 4.14). Power saws, tractors, and trucks in those days were imported technology (Rauhalahti 2006).

4.9.5 Foreign Technology in Forest Industries

The development of sawmilling technology in the early twentieth century was slow. Improved design of main sawing machines and considerable progress in sawmill planning took place. First Norwegian and later Swedish manufacturers and consultants were responsible for these know-how transfers. The interwar period was important for the development of Finnish sawmills. Then domestic know-how and manufacturing penetrated to the market (Kivimaa 1968).

The dissolving pulping method was innovated abroad in the early twentieth century. Dissolving pulp is a low yield (30–35%) bleached chemical wood pulp from the sulfite process, which has a 95% cellulose content. An alternative technology is based on sulfate (kraft) process with an acid pre-hydrolysis step to remove hemicelluloses. While other wood pulps are used for paper and paperboard making, dissolved pulp is produced for the manufacture of viscose staple fiber (rayon), acetate, and cellulose films. Three such mills were operated in Finland around 1960 (Jensen 1968).

Under rising wood prices new wood saving chemi-mechanical pulping methods were developed most vigorously after World War II in the United States. This method is based on effective mechanical defabrication and mild cooking of the chips either by sulfate or by sulfite process. The NSSC process was developed for pulping hardwoods.

In Finland it was applied especially making corrugated medium from birch (*Betula*), which was essential for increasing industrial demand for birch pulpwood during a time of decreasing demand for birch fuelwood and purposeful destruction

of young low-value birch trees. Four such mills were operated in Finland around 1960 (Jensen 1968).

There occurred simultaneously a transition in pulping from batch cooking to continuously operating digesters. The most important innovations were Kamyr, Asplund, Pandia, Bauer (M & D) and Impco, all of Swedish origin. Kamyr in particular was applied in several cooking methods. The Asplund and Pandia were suitable for producing high-yielding pulps, and the Bauer method for cooking sawdust. They found their applications also in Finland (Jensen 1968).

Bleaching of pulps has a long history since 1785, but the first part of the twentieth century revolutionized developments on this front. The application of chlorine dioxide after World War II made bleaching of sulfate pulp to a satisfactory degree of brightness operational. This innovation arrived shortly to Finland and started an expansion in Finnish pulp industry. New bleacheries were established in existing mills and new sulfate pulp mills were constructed, which created expanding demand for pine pulpwood. Also sulfite pulp mills became modernized with the introduction of chlorine dioxide (Jensen 1968).

Until 1897 only the cold grinding process was used in mechanical pulping. After that time a hot grinding process was developed for mechanical pulping in the United States. A basic innovation was a hydraulic feeding of the grinding machines. The hot process enabled higher grinding pressures and larger grinding surfaces. Hot grinding became the only mechanical pulping method in Finland until the 1960s (Jensen 1968).

New technology in papermaking arrived to Finland from abroad during the first half of the twentieth century. In principle the technology was the same as it was around 1900 but the productivity of the machines has grown immensely by increasing the width, length, and speed as well as improving the synergy of the different parts of the machine. Electric drives replaced the steam engine. The first multi-motor drive was invented in Sweden in 1926. Voith of Germany and Beloit of the United States were among the new paper machine producers for Finland (Jensen 1968).

In summary, foreign technology and know-how have been key factors in promoting Finland's transition to sustained yield forestry and industrial forestry. Imports of foreign technology have expanded and diversified the capacity of forest industries to demand more wood and more varying dimensions and tree species.

In this way the stumpage prices, forestry incomes, and value of forests have increased in support of sustained yield and industrial forestry. Foreign know-how was needed in the application of the new technologies but also in comprehending the contents of the new paradigm of sustained yield forestry.

4.9.6 International Trade

These aspects were described in more detail earlier along with the analyses of forest-based development theory in Sect. 2.6 and practice in Sect. 4.5. Therefore, only a few remarks are given here.

The role of comparatively open international trade has been fundamental for the evolution of Finnish forest industries, forestry, and forest cluster. The expansion of the exports of forest products during 1900–1960 has lead to real increases of stumpage prices and value of forests (Kuznets curve) as well as increasing labor incomes. Imports during this period have also been fundamental, especially imports of foreign technology. Export opportunities for Finnish-made technologies serving forest industries have also been important.

Finland's experience of openness of trade and large exports of forest products contrasts with the experience of contemporary tropical countries (Sect. 5.2). With strong and clear private property rights in Finland the exports were a strengthening support to sustainable forestry. In the tropical countries with socialistic forestry and weak property rights the expanding exports of forest products have increased deforestation.

4.9.7 Conclusion

The wars have had profound impacts on forestry in Finland. Postwar booms in demand for forest products have strengthened increases in real stumpage prices and the value of forest. The postwar active and large-scale privatization of state forests into family farm ownership has increased the equal distribution of forestry incomes and expanded the supply of labor for logging and floating of timber. The imports of foreign technology have expanded and diversified forest industries and demands for various assortments of roundwood. They have in this way advanced forest-based development and the transition from preindustrial to industrial forestry.

International and global forest and environmental politics hardly had any impact on Finnish forestry between 1900 and 1960. Both before and after this period major foreign transitions of sustainability paradigms affected Finnish forestry.

We end here our detailed review of Finland's transition to industrial forestry to 1960. A multiple and deep transition towards postindustrial forestry took place during the half a century since 1960. We shall next give a summary of this evolution. A more detailed description will be published later.

4.10 Transition to Postindustrial Forestry After 1960

The evolution of multiple use forestry can be viewed as a transition from sustained yield forestry to SFM. The idea arrived to Finland in the 1960s. The first symptoms of de facto changes in practical forestry could be observed in the 1970s. Protected forests and peatlands were open to other multiple uses but not for logging.

The Forest Service protected 150,000 ha of peatlands in 1973. Somewhat later 490,000 ha more was protected by the national peatland programs. About 150,000 ha of the total were located on private lands. The government decided to expand

national parks and nature reserves (1978), the primary program for protection of peatlands (1981), the program for protection of watercourses for birds (1982), and the program for protection of ridges (1984). The area of national parks had been increased to 0.8 million ha by 1983 (Hellström and Reunala 1995).

The weakest link in the road towards sustainable forest management in Finland is maintaining of social sustainability. It is one of the three objectives of the 1996 Forest Act but it may be an impossible task in a dynamic social change to advance social sustainability in forestry only. The issue may be better handled as a multi-sector issue in the national economy.

Prevailing non-industrial private forest tenure, social and spatial aspects in public subsidies, open access to all forests (common right of access), increasing appreciation of recreation and other services of forests and increased participatory approach in planning the use of public forests can be regarded as supporting social sustainability in forestry.

After the remarkable effort of measuring 35 quantitative and describing 12 descriptive indicators of SFM in Finland in 2007 the editors were not able to conclude the degree of SFM achieved in comparison with some earlier time in Finland or with other countries (Parviainen et al. 2007). This implies the inadequate state of the Finnish and international systems of Criteria and Indicators of SFM.

This conclusion is more convincing in comparison, for example, with the Human Development Index of UNDP or the Corruption Perceptions Index of the Transparency International or the various GNP or other national income computations by the UN and the World Bank. These systems are based on coherent theories and arrive to integrated indexes, which facilitate quantitative comparisons over time and space.

We have analyzed that the *de jure* transition of Finnish forestry to SFM took place until about 1998. Later on it was strengthened by numerous formal and informal institutions. Globalization of forest and environmental politics and policies and globalization of forest industry corporations jointly created pressure on the government and the forest owners to also speed up the transition to de facto SFM. In only about 15 years a revolution in forestry practices towards de facto SFM has taken place.

We assume that it is difficult to find another country in the world that is be more advanced than Finland in the enforcement of *de jure and* de facto criteria and indicators of SFM. Costa Rica may be another country with comparable progress in SFM. Social and ecological sustainability pose the remaining challenges for Finland in order to arrive at a full SFM.

In 1996 the Finnish government allocated 3.3 billion FIM (EUR 0.547 billion) for the enforcement of forest protection plans until 2007. In 2005 strictly protected forest areas covered 0.7 million ha or 3.2% of total forest area in Finland. These figures exhibit themselves favorably in international comparisons. In the European Union only Estonia (5.8%), Greece, and Slovakia (4.2%) had somewhat higher percentage of protected forests than Finland. However, the total protected forest area was highest in Finland (Ylitalo 2010).

As a recognition of advanced SFM in Finland a number of Finnish foresters and forest scientists have been lately nominated into leading positions in global forestry organizations. For example, Pekka Patosaari lead the United Nations Forest Forum (UNFF) from 2000 to 2007, Risto Seppälä was the President of the International Union of Forest Research Organizations (IUFRO) from 2000 to 2005, and Jan Heino was Assistant Director General of FAO and the Head of the Forestry Department from 2006 to 2009.

A more detailed analysis and description of Finland's transition from industrial forestry to postindustrial forestry will be published in forthcoming book.

Next we will end this chapter with a discussion of our findings and conclusions.

4.11 Discussion and Conclusions

4.11.1 Comparisons with Other Studies

It is evident that the theoretical framework has had a strong influence on our findings. It has been like a microscope for geneticists or a telescope for astronomers in selecting relevant observations among masses of historical data and information. The reliability of our findings is dependent not only on the reliability of the historical facts and data but also on the quality and relevance of our theory and approach. Simultaneously a rigorous empirical test of the hypotheses of Fig. 2.4 has been carried out.

So far, hardly any of the numerous scholars engaged in studies on Finnish forestry history have specifically focused on the transition processes from preindustrial to industrial forestry. Raumolin (1984) studied "The Formation of the Sustained Yield Forestry System in Finland." His study is more of a descriptive one than an attempt to identify the causes of the transition to sustained yield forestry. Kuusela studied long-term historical changes in the forest resources in Finland but without theory and causal analysis of the transition (Morin et al. 1996).

Parviainen and Seppänen (1994) were the rare authors in Finland, who have described the evolution of the concept of sustainable forestry and its transition from sustained yield forestry (SYF) into multiple use forestry and later on into sustainable forest management. However, they did not identify the timing for the de facto transition into SYF and potential causes of this transition.

Hellström (1993) studied the underlying factors of deforestation in Finland between 1977 and 1986 as defined by the Private Forest Law. She found poverty, attitudes against a paternalistic society, and self-satisfaction of an independent farmer as such factors. She analyzed the relationship of the Private Forest Law to sustainable forest management and concluded that the law matched only with the sustainability of forest area and not with the sustained cutting possibilities. Owners of large forest and active timber producers were most agreeable to the management practices allowed by the law and as interpreted in its enforcement. We may assume that similar factors were also effective earlier.

Siiskonen (2007) made an interesting contribution on "The Conflict Between Traditional and Scientific Forest Management in 20th Century Finland." He described thoroughly the conflicting situation between the farmer forest owners and the foresters in the enforcement of the Private Forest Law of 1928 until the early 1980s.

According to him "scientific forest management" was something that was described in the law and that the enforcement authorities were supporting. The two-centuries-old paradigm of sustained yield forestry (SYF) was excluded from this paper. He missed a comparison between the law and the contents of SYF. The author did not specify that the law had natural regeneration as the basic alternative and artificial regeneration as an exception. Still, enforcement required mostly artificial regeneration since the end of the 1950s.

Palo and Uusivuori (1999) wrote about "Forest-Based Development in Finland – A Unique Success?" They analyzed firstly the issue of the title in the Westobian tradition by assessing first how forestry and forest industries have influenced the socio-economic/environmental development in Finland. The primary focus was on their direct impacts and secondarily on indirect impacts through their linkages to the rest of the society. They secondly related the forest-based development to the sustainable forest management with economic, ecological, and social dimensions. In this book we advanced their analyses on the first point but have not yet addresses the second point.

Vehkamäki (2006), however, was perhaps closest to our research in this book. He studied the birth and arrival of SYF to Finland with many illustrative narratives. He described well the prehistory of SYF in Germany, but he missed a theory to observe the critical causes of this forest transition in Finland. He did not identify the timing, when SYF did de facto arrive to Finland. He largely missed the role of markets, productivity of agriculture, and the transition in the use of energy as major underlying institutions in support of transition to SYF. Similarly, he regarded the Forest Act of 1917 as the first effective formal institution in support of the transition.

Hirakuri (2007) made a study on "Sustainable Forest Management and Law Enforcement: A Comparison Between Brazil and Finland." However, the comparison was done simply by comparing institutions supporting deforestation in Brazil with those supporting sustainable forestry in Finland. She regarded Finland as a model country for Brazil but without any theory. It may appear risky to compare two countries with such huge differences in land area, population, ecology, culture, economy and public administration. In fact, in a case study generalizations should be made against a relevant theory (Yin 2003).

4.11.2 Novel Findings

The most surprising novel finding of this chapter was that de facto transition to sustained yield forestry in 1900–1910 appeared prior to *de jure* transition 1917–1960. After the enforcement of the Great Land Reform and the Forest Service and

liberalization of some general legislation, the market institutions were the driving forces to end deforestation by shifting cultivation, tar, and wild fires.

With increasing demand for industrial logs the value of forest started to increase and the social opportunity cost of deforestation also increased. The positive role of the markets, "invisible hand" or "the Kuznets curve," and the related forest-based development in support of sustainable forestry is unfortunately missing from most of the contemporary tropical countries (Sect. 4.1).

Another interesting and surprising finding was that sustained yield forestry was not explicitly mentioned as an objective in the various forest acts and laws before the 1994 Law on the Forest Service. The 1917 Act and 1928 Law on Private Forests only banned deforestation, which would prevent decrease in forest area. The 1917 Forest Act included only a minor instrument, rational tending of young forest, to prevent decreases in growing stock and future cutting options.

However, SYF was the fundamental paradigm in forestry textbooks and education. It was also since 1923 under continuous follow-up by Metla. *De jure* SYF or even today SFM are mostly clearly expressed in the formal institutions of the contemporary tropical countries, but in vain – large-scale deforestation is continuing in the tropics (Sect. 4.4).

Finland experienced a regulation of private forests by professional foresters during our period of study in this chapter, 1918–1960. First, the state foresters were only implementing the 1917 Forest Act. Since 1928 the foresters were also promoting investments in forest management intensification and practicing extension of rational forestry management guided by the semiofficial provincial forestry boards.

Finally, since 1950 the numerous local Forest Management Associations were also integrated in this promotion of the sustained yield forestry paradigm to the farm forest owners. Its diffusion among the farmer forest owners faced numerous problems but gradually the level of silviculture was somewhat raised (Sect. 4.5).

Forest products were dominant in the total commodity exports from Finland for a century until 1970. The expanding exports played a key role in promoting economic growth in a small country like Finland. Also the terms of trade remained positive due to minor imported inputs by the forest industries. Forest-based development with sector differentiation was additionally realized in Finland due to strong forward, backward, investment, consumption, and agricultural linkages by the expanding forest industries. The domination of farm forestry created important income distribution impacts both spatially and structurally (Sect. 4.6).

The forest industry corporations have benefited from the long-lasting privatization and colonization of forests in Finland. Due to the large-scale colonization the inhabitation became widely distributed among the vast forests. Therefore, the supply of loggers and horses for extraction of logs was accessible in most parts of Finland. Only in the most remote forests in northern and eastern parts were specific logging camps created, with additional costs for the corporations (Sect. 4.8).

The coevolution of forestry and agriculture was most effective from 1900 to1960. Farmer forest ownership prevailed. Forestry incomes were expanding due to both increasing roundwood production and increasing real stumpage and delivery prices. Both manpower and horsepower were efficiently rotated between agriculture and

forestry. A major part of the forestry incomes were invested in raising productivity in agriculture. Expanding productivity decreased pressure on clearing more forests for permanent fields (Sect. 4.8). Unfortunately, this kind of coevolution is largely missing in most tropical countries.

Wartime depressions of exports increased the growing stock of timber. The post-war expansion of demand by wars has usually also meant increasing real stumpage prices, making forests more valuable. Low-value forest resources have mostly been deforested and high-value forests sustained. However, wars alone have not made this transition but a complex process of many simultaneous factors has been required (Sect. 4.9).

Foreign technology and know-how have also been key factors in promoting Finland's transition to sustained industrial forestry. Imports of foreign technology have expanded and diversified the capacity of forest industries to demand more timber and more varying dimensions and of varying tree species. In this way the stumpage prices, forestry incomes, and the value of forests have increased in support of sustained yield and industrial forestry. Foreign know-how was needed in the application of the new technologies but also in comprehending the contents of the new paradigm of sustained yield forestry (Sect. 4.9).

A fundamental finding of this chapter was the outcome of the empirical testing of the hypothesis of our model of Fig. 2.4. Our testing with historical data and information could not falsify the hypothesis in the meaning of Karl Popper (1959). The hypothesis of the universal system causality model of forest transition will remain so far valid. We shall make further empirical testing of it in Chap. 5.

If Finland was able to transit to sustained yield forestry in the early twentieth century, there was an early deterioration of other goods and services by forests. Sable, wolf, bear, two eagle species, a few hawks, and moose became extinct or nearly extinct. The population of squirrel was also largely exploited, because it was the most common commercial commodity for many centuries. Salmon and other species fisheries suffered from the expanding timber floating and finally salmon was gone from the rivers after World War II due to hydropower construction (Åström 1978).

The expanding forest industries caused water pollution and local air pollution. Accordingly, a transition to forest-based development and industrial forestry also had other drawbacks in environmental deterioration, which started to become more apparent later, along with the intensification of forest management since the 1960s. After 1962, new water legislation gradually improved the quality of waters.

4.11.3 Public Polemics in Agenda Formation and Roles of Key Individuals

In the early twentieth century a useful public discussion took place in advance of integrating the Forest College to the University, establishing the Forest Research Institute, and adopting the 1917 Forest Act.

Kalle Kajander (1901) initiated public debate on corporate ownership of forests, describing the poor conditions of many farmers who had sold their forests to corporations. Renvall (1915) made his study on this theme and tried to support the idea that corporations were superior forest owners in comparison with farmers in relation to SYF. Then the formal institutions arrived to regulate the purchases of forest holdings by corporations.

A similar discussion was going on since 1914 (e.g., Pekkala 1922) to criticize the integration of forestry extension with agriculture (Helander 1949). A Committee for private forestry was set up in 1924 and subsequently in 1928 the major reforms arrived.

The role of individual actors in key vacancies in the government is another precondition to forestry reforms. We may identify A.K. Cajander, Mauno Pekkala, and N.A. Osara during 1900–1960 in such roles. Naturally, the vested interests and political parties with their political power have always played their own key roles both in agenda formation and in final enforcement of these reforms.

4.11.4 Conclusions

The analyses of this chapter followed the disposition of the universal system causality model of forest transition in Fig. 2.4. Our findings of the underlying causes of forest transition in Finland are summarized according to the same model below.

1. *Ecological factors*:
   - Only a few commercially valuable tree species made logging and silviculture simple: pine (*Pinus sylvestris*), spruce (*Picea abies*), and birch (*Betula pendula*, *B. pubescens*).
   - Natural regeneration was vigorous and promoted increasing growing stocks of timber and in this way also SYF.
   - Low-cost logging conditions due to easy terrains and long winters with ice and snow to facilitate log extraction by horse and sled.
   - The conditions after logging had minimal erosion.
   - 200,000 lakes with numerous rivers and creeks facilitated low-cost timber floating in a labor-intensive way.
   - Numerous rapids provided water power for sawmills, mechanical pulping, and electricity for paper and paperboard production.
   - Finland's location next to rapidly industrializing western Europe was favorable.
   - Long seacoasts provided numerous harbors for exports.
   - In comparison with tropical countries these ecological aspects were decreasing costs and risks in forest management, logging, and transport of logs in Finland. Low costs improved profitability in forestry and facilitated higher incomes for forest owners and loggers. Finally, alleviation of poverty and a decreasing pressure on forests occurred in Finland.

2. *Knowledge institutions*:

   – College of Forestry at a remote wilderness village of Evo, 145 km northeast of Helsinki, 1858–1907.
   – Forestry ranger schools at Evo, 1875–, in four other locations, 1905–
   – School of Forestry, University of Helsinki, 1908–
   – Forest Research Institute Metla, 1917–
   – Three national forest inventories linked with three national surveys of wood consumption in 1921–1960 as a continuous follow-up of increment, drain and growing stock as well as facilitating computations of national and sub-national sustainable cut. Metla has been responsible for maintaining these indicators of de facto SYF.
   – Private research on efficiency of logging by Work Efficiency Association (Työtehoseura), 1942–, and by Metsäteho, the Research Department of CAFFI 1944–.
   – These knowledge institutions increased know-how about forestry to community institutions, farm-forest owners, forestry experts, and loggers as well as to the government and the public at large in support of transition to SYF.

3. *Property institutions*:

   – Great Land Reform (Isojako) 1757–1910 (1964) granted strong and clear property rights primarily to the farmers and secondarily to the state.
   – Farming families received a majority in forest ownership.
   – Operational courts and honest police corps made property rights defendable for the farmers.
   – The Great Land Reform closed open access to timber resources in private farmer-owned forests, when the village forests primarily were divided among the villagers and afterwards each forest holding had a local owner.
   – Clear and strong property rights established a basis for functioning of the market institutions but also for the public regulatory institutions.
   – The majority of forest-ownership by farmers equalized income distribution and alleviated poverty in support of SYF.
   – Establishment of joint stock companies became feasible after the law of 1873, which was important for the expanding forest industries.
   – Forest holdings were liberated from a wide family tree ownership (sukuperintöoikeus) – selling a forest holding outside the family was feasible since 1877. This was a decisive step towards markets of forest holdings – a prerequisite for competitive roundwood markets.

4. *Market institutions*:

   – Expansion of foreign demand for forest products, expansion of domestic forest industries, and increasing demand for industrial roundwood.
   – Increase of real stumpage prices of sawlogs by 1% per annum 1870–1920, 2% per annum 1920–1964.

- Increase of real value of private forest and forest holdings.
- Increase of social opportunity cost of deforestation.
- Increase in stumpage and labor (man and horse) incomes to farmer forest owners.
- Increase in labor incomes in logging, timber floating and forest industry mills for landless local people.
- Gradual alleviation of rural poverty, which released pressure on forest degradation and deforestation.

5. *Community institutions*:

- Royal Economic Association (Kejserliga Hushållningssällskapet i Finland) since 1809 was an early "think tank" on forestry issues and produced material for extension of forestry.
- Finnish Forest Association (Finska Forstföreningen) since 1879 acted in the same way.
- Two state-sponsored consultants to support private forestry by extension in 1873.
- Finnish Economic Association (Kansantaloudellinen yhdistys) began sponsoring and publishing forest-related studies in 1884.
- Society of Silviculture (Metsänhoitoyhdistys) Tapio was active in extension beginning in 1907.
- Society of Forestry Culture (Skogskultur, for a minority of Swedish speaking private forest owners) also in forestry extension starting in 1912.
- Many Forest Management Associations were established in 1908.
- All these institutions increased knowledge about the benefits of SYF, increased the effectiveness of forestry extension, and in this way supported transition to SYF.

6. *State regulatory institutions*:

- The 1851, 1859, 1907, and 1922 laws on State Forest Service (Metsähallitus) created the rules and local managing staffs for the state forests.
- The private forest laws of 1917 and 1928 were designed to close deforestation and forest degradation.
- The 1928 law on District Forestry Boards linked extension in addition to the law enforcement to these boards.
- The 1928 forest improvement act mobilized intensification of forest management by cost-sharing basis in private forests.
- The 1928 act on the lodging of the loggers initiated various regulations to promote their social conditions.
- The 1936 law on timber scaling created a basis for fair exchange of timber and improved the functioning of the timber market.
- The 1950 law on forest management associations was essential in increasing the local capacity for forestry extension.

7. *Enforcement of institutions*:
   - A continuously increasing number of well-educated forestry experts were recruited to effectively enforce the 1917 Forest Act, the 1928 Private Forest Law, the Forest Improvement Laws of 1928, the 1950 Law of Forest Management Associations, and other forestry legislation.
   - State forests remained only about one quarter of the total forest area. Positive financial returns were stressed as a primary objective for the Forest Service, which developed auctions and delivery sales with price references from the markets of the private forestry. The Service also supported the establishment of new state-owned sawmills and pulp mills in order to create more demand for its timber harvests in the remote state forests.
   - Practically no corruption was observed among the enforcement staffs of private and state forestry, because the state forests were only in a minority position, the special education of civil servants had stressed honesty and moral codes since 1809, and the Lutheran church gave its strong support for this. Also transparent democracy and the liberty of media in Finland were important to preventing corruption. Low corruption supports SYF.
8. *Forest-based development*:
   - Finland has followed an export-led economic development for more than a century. Forest products exports composed 70–90% of the total value of all the commodity exports between 1920 and 1960. This made forests a key resource for the national economy and motivated the governments to support a transition to SYF.
   - Increasing European demand for forest products expanded the demand for roundwood in Finland. The value of forests increased accordingly. Increasing forestry incomes alleviated rural poverty and released pressure from forests.
   - The capacity of pulp and paper industries was increased substantially. Machinery was purchased earlier from abroad but later more and more from Finland. Especially after World War II a forest cluster was created by producing increasingly machinery, consulting services, and other inputs for forest industries from Finland. This diversified the economy in a positive way and alleviated poverty.
9. *Coevolution of forestry and society*:
   - Forestry and forest industries were able to coop the society by providing three Prime Ministers and seven ministers during 1920–1960 for the society. A.K. Cajander, Antti Hackzel, and Mauno Pekkala were the Prime Ministers. As a consequence, the political power generated numerous benefits but also public regulation to the forest sector and strengthened the drive towards SYF.
   - Forest industry firms invited noted architects, led by Alvar Aalto, to design plans for towns around their mills and various buildings in these forest towns. The firms also invited painters and sculptors to decorate these towns and buildings and to create art collections. These actions strengthened the image

of the forest industry firms among the citizens and politicians alike and created a beneficial atmosphere for their future operations.
- A number of authors, led by Aleksis Kivi, wrote novels and poems about forests, logging, log floating, and work in forest industries.
- Numerous composers, led by Jean Sibelius, created music based on these novels and poems or with pure inspiration from the wilderness.
- In a similar way 27 full-length narrative films were based on these literary works. About 400 documentary films were produced to illustrate forest sector activities.
- These artists strengthened the image of the forest sector and motivated society and the government to support SYF.

10. *Inter-sector impacts*:

- Saturation of human population growth decreased pressure on forest degradation.
- New financing sources of forestry incomes in farm forestry and growth of saving and cooperative banks increased productivity in agriculture, which again reduced need for additional conversion of forests to fields.
- The men and horses worked in farming during late spring, summer, and fall and in logging in winter, and men worked in timber floating in early spring. This rotation of manpower and horsepower was profitable to both farming and forestry.
- Increasing imports of grains from Russia until 1917 and decreasing prices lowered cost of living and alleviated poverty, which again released pressure on the forests.
- Increasing industrialization and urbanization decreased rural population pressure on forests.
- Human development by increasing capita income, education, and health alleviated poverty.
- Substitution of fuelwood for fossil fuels opened space for expanding industrial logging without increasing total timber drain since 1950.

11. *International impacts*:

- Western Europe was intensively industrializing since about the middle of the nineteenth century and had largely deforested its own forests. This caused increasing international demand for forest products from Finland, which increased stumpage prices, values of forests, and forestry incomes in Finland.
- The paradigm of sustained yield forestry (SYF) was transferred from Germany to Finland.
- The technology change from wooden ships to iron ships decreased the demand for roundwood used for wooden ships and tar.
- Technology innovations of wood pulping, wood-based paper and paperboard, paper machine, steam engine for sawmills, electricity for paper mills, as well as of railways, telegram, and telephone were imported to Finland in

Photo 4.13 Old growth forest in southern Finland under midnight sun during a summer night. Repovesi National Park (Photo: M. Passinen)

order to decrease production costs and diversify forest industries and increase their demand for various roundwood assortments.

– The postwar demands and prices for forest products in reconstruction of war damages and in speculation (the Korean War) increased the stumpage prices, value of forests, and forestry incomes for local people. This decreased the social opportunity cost of sustained yield forestry and promoted SYF.

All these findings on the underlying causes of forest transition in Finland from deforestation to SYF would not be possible without the *ex post* application of the universal system causality model of forest transition in Fig. 2.4. No weighting of the causes was introduced above. However, some of these causes can be identified as instrumental or mobilizing "chemical causation" processes according to John Stuart Mill (Sect. 2.7).

Strong and clear property rights supporting local farmer ownership of forests under non-corruptive conditions can be regarded as one primary chemical causation factor by facilitating market and regulatory institutions with comparatively equal income distribution. Another one the strong forest-based development that alleviated poverty and decreased the social opportunity costs of SYF. Both of these chemical causation instruments are missing in most tropical countries. As a consequence deforestation has continued unabated in the tropics.

Finland has strongly utilized its forests during the last 100 years but has more forest than ever known in 200 years (Photo 4.13).

We shall use the same hypotheses of Fig. 2.4 for the specification of our quantitative modeling of deforestation in the tropical countries in Chap. 5.

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